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D.S.S. Contract 14 Su. 23440-2-9075.
D.S.S. Contract 25 St. 23440-3-9100 → OSTB3-00093
Serial No: ~~OSU82 - 00204.~~
Principal Investigator: Dr. R.W. Smith.

Title: Development of a Computer Assisted Risering Programme and its Commercialization.

FINAL REPORT May 22, 1984

MICROMEDIA

201 pp

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GENERAL STATEMENT

Dr. R.W. Smith and Dr. M.R. Viner of the Department of Metallurgical Engineering of Queen's University at Kingston, Ontario have been collaborating with Mr. R.K. Buhr, Dr. R.D. Warda, Dr. K.G. Davis, and Dr. L.V. Whiting of PMRL, CANMET, in the development of a user-friendly casting programme. This is concerned mainly with the risering of steel castings, but includes a description of gating sufficient to permit accurate calculations of casting weight and yield, and also of costs. The latter includes the optional use of riser sleeves, topping and cleaning costs.

The programme permits the user to calculate the modulus of casting sections, making use of high resolution graphics to describe the casting sub-sections as a sum of elementary shapes. Additionally, the user may describe a complex sub-section by drawing its cross-sectional profile on a graphics tablet. Feeding distances are calculated for rectangular sections for situations involving no chills, chills and padding. The riser size is then calculated following a method developed by Dr. K.G. Davis of PMRL, CANMET, which calculates the shape of the shrink profile within the riser and displays it on the high resolution graphics screen.

In carrying out the development of the programme, in most cases it was necessary to inspect the original foundry science publications. Frequently, it was found that the summaries appearing elsewhere misquoted the earlier results. Also, it was found that there were many gaps in the available data.

There follows a series of sections which more fully describe various aspects of the programme which is now being tested on foundry science students and in a commercial steel foundry.

SOMMAIRE EXECUTIVE

Dr. R.W. Smith et Dr. M.R. Viner, au departement de métallurgie à l'Université de Queen's à Kingston, Ontario, sont en collaboration avec Mr. R.K. Buhr, Dr. R.D. Warda, Dr. K.G. Davis et Dr. L.V. Whiting de PMRL, CANMET afin de développer un programme de coulée facile à utiliser. Ceci concerne principalement le calcul de masselotte de la coulée de l'acier mais aussi comprends une description suffisante du système d'alimentation qui permet d'estimer plus précisement le poids, le rendement et aussi le coût des coulées. L'usage optionel de l'isolation de masselotte, l'éboutage et le nettoyage sont aussi inclus dans le coût.

Le programme permet à l'usager de calculer la module des sections des coulées en utilisant des graphiques à grande résolution pour décrire des sous-sections comme la somme des formes élémentaires. En plus, l'usager peut aussi décrire une sous-section complexe sur un tableau à graphique. Les distances d'alimentation sont calculées pour des sections rectangulaires pour des cas où on n'utilise pas d'éprouvette de trempe ou surépaisseur d'alimentation. On peut alors calculer la dimension de masselotte d'après la méthode développée par Dr. K.G. Davis de PMRL, CANMET qui permet de calculer le profile de retassure dans la masselotte et la montre sur un écran a grande resolution.

Pendant q'on développait le programme, il a été nécessaire dans de nombreux cas de s'addresser à la bibliographie originelle en science de fonderie. On a constaté assez fréquemment que des résultats présentés auparavant étaient faussement cités dans des extraits parus ailleurs. D'autre part, on s'est rendu compte qu'il y avaient des lacunes parmi les data obtenus.

Finalement, une série de sections qui décrit des aspects variés du programme d'une manière plus détaillée est appliquée a présent aux étudiant en fonderie et dans la fonderie commerciale de l'acier.

CANMET RISERING PROGRAMME

FEATURES

- No computer experience necessary. Interactive features minimize input errors and facilitate corrections without re-entry of all data.

- Makes allowance for the effect of molding material and molding process on both feeding distance and riser design. Parameters for the most common molding materials and processes are built-in.

- Uses up-to-date information on feeding distance and gating system design.

- The casting section description may include the separate description of up to 10 sub-sections (appendages) of different modulus.

- Complex casting cross-sections can be entered via a graphics tablet.

- The computer will suggest the best sub-section for riser placement, but the operator may over-ride the choice.

- Several riser configurations may be examined without re-entering the casting section description, allowing the operator to obtain the optimum riser design quickly.

- The computer draws a picture of the riser shrink profile for a given riser design: hence the operator can see graphically the result of selected departures from the computer-chosen optimum riser size.

- For a given casting, up to 10 different riser designs may be stored on magnetic disk. Each riser design may be used on one or more identical casting sections (e.g. sections of a large wheel).

- All casting sections and risers may be summed in order to calculate gating system parameters for the casting as a whole.

- Accurate casting, including sleeve and cleaning costs, may be generated for individual sections or for the whole casting. Costs for the whole casting include the gating system.

- The Master Program Disk, and the programs on it, are not copy-protected. Hence the user may modify the programs using his own proprietary data, and make as many backup copies as he requires.

REQUIREMENTS

To use the CANMET risering package, you will need:

- an Apple IIe or Apple II+ computer, with 64K of RAM memory,
- a television, or a monochrome or colour video monitor,
- at least one disk drive for 5 1/4" magnetic disks with disk controller card,
- the Apple disk operating system DOS 3.3.

A printer and printer interface card are not required, but are highly recommended for making permanent records of feeding distances, riser designs, and costs. A second disk drive is recommended for speeding up the creation of backup copies of disks.

Due to the length of some of the programs on the disk, the use of a proprietary disk operating system such as TDE Quickdos (S & H Software) or Diversi-Dos (DSR, Inc.) is recommended. These operating systems speed up the loading of program files by a factor of 4-5 over DOS 3.3, reducing some of the waiting time between programs.

WARNING: The CANMET Risering package has been tested with DOS 3.3 and the above proprietary disk operating systems. However, the program RAMDISK will not work with PRODOS, and may not work with other operating systems.

CANMET RISERING PROGRAMME

SCIENTIFIC BACKGROUND

I FEEDING DISTANCE

The feeding distance of a given section will depend on the thermal gradient along the section and on the thickness of the section. Since a chill or an end face will increase the thermal gradient near to it, the feeding distance toward chills and end faces is longer than that towards another riser. In addition, the feeding distance of plates will be somewhat longer than that for bars.

Our feeding distance calculations are based on the analytical heat flow studies of J.F. Wallace, W.D. Spiegelberg, and R.D. Maier at Case Western Reserve University, as reported in the booklet "Risering Steel Castings," Steel Founders' Society of America, 1973. These are referred to as the SFSA feeding distances.

In the SFSA system, rectangular sections of width W and thickness T (W > T) inches are called "bars" if W = T and "plates" if W > 2T. The following feeding distance formulae are for "semi-plates" with widths between T and 2T. The same formulae are used for plates, but with the W = 2T substitution.

In the SFSA monograph, equations F-8 (bars) and F-9 (plates) are inconsistent with equation F-10 (semi-plates) in the appropriate limits. By comparison with their graphs, it would appear that F-10 is the better choice; that is our equation F_3 below.

In all cases, the equations strictly apply only to sections with thickness greater than 2 inches, since feeding distances for thinner sections are strongly influenced by the method of gating.

The feeding distance from the edge of the riser towards a cooling end face is

$$F_1 = 7.24 \sqrt{W} + 1.51 \sqrt{T} - 5.67 \text{ inches}$$

The "lateral" feeding distance from the edge of the riser towards another riser is

$$F_2 = 0.84 \sqrt{W} + 3.38 \sqrt{T} - 2.34$$

The feeding distance from the edge of the riser towards an end chill is

$$F_3 = 9.14 \sqrt{W} + 4.12 \sqrt{T} - 11.40$$

The feeding distance from the edge of the riser to the edge of a drag chill - i.e. a chill placed between risers - is

$$F_4 = 10.80 \sqrt{W} - 1.64 \sqrt{T} + 0.88\ T - 0.76\ W + 0.21 \sqrt{CW} - 7.04$$

The chill thickness is assumed to be 0.6 T, and the maximum width of any drag chill is

$$CW = 2.24\ W - 6.02 \sqrt{W} + 2.60 \sqrt{T} + 6.0$$

In the program, F_4 is calculated for the maximum chill width.

A taper may be applied to the upper or lower surface of a casting to produce the thermal gradient necessary to feed any length to soundness. The slope of the taper for a given section size is

$$SL = 0.0648\ T - 0.0164\ W$$

In this case, T is the thickness of the section before the application of the taper. The taper is not required over a limited distance near the riser and near the end face of the section. The former distance can be calculated from F_2, while the latter is given by

$$F_5 = 3.16 \sqrt{W} + 1.39 \sqrt{T} - 3.19$$

It should be noted that the use of a taper to extend the feeding distance can substantially increase the section thickness at the riser. If the taper is to be ground off, this may prove more expensive than the use of chills or additional risers.

Parasitic sections are not treated in the SFSA monograph. However, the early NRL paper on the subject (E.T. Myskowski, H.F. Bishop and W.S. Pellini, Trans AFS 61,302, 1953) only covered the range of thicknesses from 1 to 4 inches. Thus their work would be very difficult to extrapolate to thicker sections. As a result, feeding distances for parasitic sections should be calculated as if they were fed from a riser, but treated with caution.

All of the feeding distance formulae above are for green sand molds. For molding materials with greater chilling ability, the thermal gradient along the casting will be decreased, and the sound feeding distance will be shorter.

II RISER SIZE CALCULATION

INTRODUCTION

The CANMET risering program is based on the premise that the only accurate way to predict the effectiveness of a riser is to calculate its shrink cavity profile. A riser with a shrink cavity that ends comfortably short of the riser/casting junction is considered "safe". In the modulus approach to riser design, treated comprehensively by Wlodawer, the riser shape is assumed to be parabolic. This is also true for the later variations on the modulus approach developed by Ruddle. While considerable success has been obtained using these approaches, they have certain intrinsic drawbacks. First, a proper treatment of a casting with several appendages is not possible, for the riser design is based solely on the modulus of that portion of the casting to which the riser is attached. The only effect of the appendages is considered to be an effective decrease in the cooling surface area of the casting, equal to the total casting/appendage junction area.

A second drawback to the simple modulus approaches is that they predict a safe riser, but give no indication of how sensitive successful feeding is to the riser dimensions. For example, such methods may predict a safe riser 7.5 inches in diameter for a particular casting and mould layout. Suppose the foundry has patterns for 7-inch and 8-inch risers. Is a seven-inch diameter riser adequate? The CANMET program allows shrink in the 7-inch riser to be displayed, and a decision on its effectiveness can then be made.

There are other areas where the CANMET system has advantages. Mold wall movement can easily be treated, and the effect of the change in modulus of a section as the other sections to which it is attached freeze off can be approximated.

Ideally, an exact riser shrink profile can be determined only through a complete heat and mass flow analysis of the riser/casting assembly. This would need a finite element or finite difference treatment with a large computer, and so a compromise must be made. In the CANMET program, a variation on the modulus approach is used to describe solidification in the casting sections. The extra sophistication of this method compared with a simple modulus approach necessitates a more detailed data input from the user, in order to describe the junctions between the various sections. The added precision obtainable should however more than compensate for the small amount of extra time required.

THE BASIC DEVELOPMENT

The two main assumptions in deriving the equations for shrink profile are: -

1) The fractional solidified volume within the casting, the riser, and the appendages is $\alpha\, t^{1/2}$, where t = time after pour. This is equivalent to assuming a rate of solidification, $(dV/dt)\ \alpha t^{-1/2}$.

Thus if V is the initial (liquid) volume in a particular section,

and VS is the volume solidified at time t after the casting has been poured,

$$VS/V = K \times t^{1/2}$$

This assumption is accurate for a flat plate. It has also been checked and found nearly correct for a cylinder solidifying from the side walls, and is likely sufficiently accurate for other shapes.

For the riser, the definition of "volume solidified", VS, has to be defined. The shape of the riser shrink cavity depends on the rate of solidification of the casting plus appendages relative to the rate at which the solidifying riser wall increases in thickness. VS/V is therefore equal to $(R^2 - X^2)/R^2$. Were no heat lost from the top surface, the modulus of the riser would be D/4, where D is riser diameter. However heat lost from the top will decrease the effective riser modulus. This aspect will be considered in more detail later.

Risers are often lined with either exothermic or insulating sleeves, so their heat loss rate is reduced compared with that for a sand mould. To allow for this, the riser modulus has been divided by an "apparent surface alteration factor", ASAF.

2) The total solidification time for each section is assumed proportional to the square of the modulus for that section where modulus M is defined as the ratio of volume to total cooling surface. As each appendage solidifies, the equation for the riser shrink profile changes, producing 'zones' of solidification where a particular equation holds (see below).

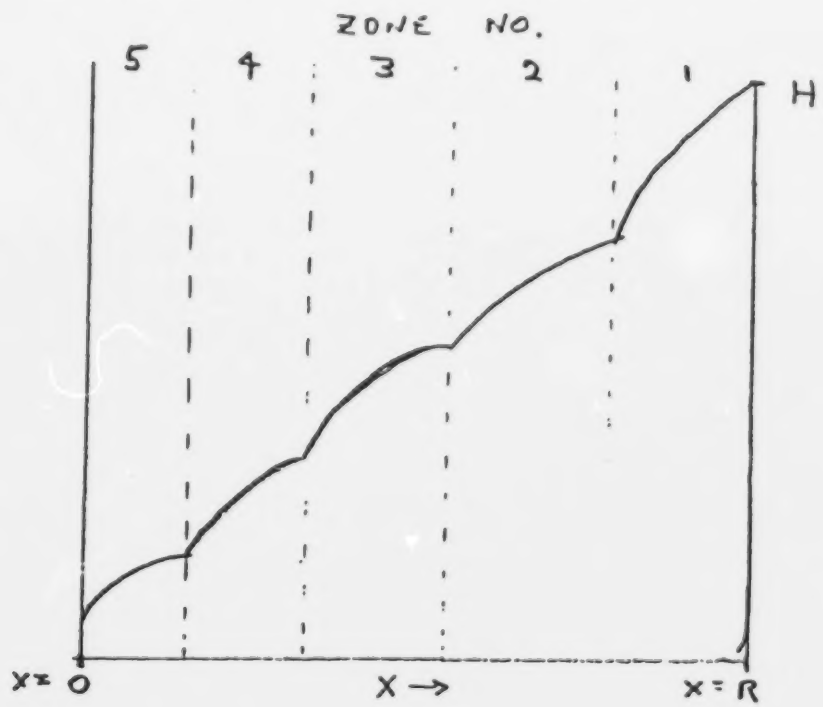


Fig 1. Shrink zones in a riser with three appendages (numbered 0,1,2,).

Zone	Components Solidifying
1	riser + casting + appendages 0,1,2
2	riser + casting + appendages 1,2
3	riser + casting + appendage 2
4	riser + casting
5	riser

The equation for zone N is

$$\frac{Y + \frac{MR}{\pi R^2} \cdot \frac{A(N)}{ASAF}}{YC + \frac{MR}{\pi R^2} \cdot \frac{A(N)}{ASAF}} = \left(\frac{X}{XC}\right)^{2S} \quad \ldots\ldots(1)$$

Here MR = riser modulus, S = shrink (defined as (VL-VS)/VS), and XC and YC are defined in Fig 2. below. VL is the liquid volume before solidification.

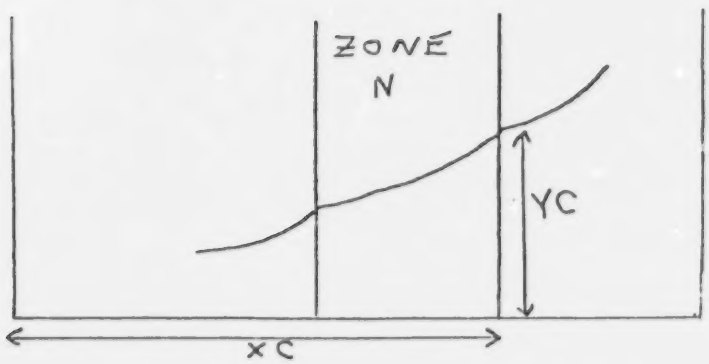


Fig 2. Definition of "critical" X and Y, XC and YC, for solidification zone (N-1).

$$A(N) = \frac{VC}{MC} + \Sigma \frac{VA}{MA}$$

where VC = casting volume, MC is casting modulus, and Σ VA/MA is the sum of the volume/modulus ratios (equivalent to the total cooling surface area) for all the appendages taking part in the solidification of zone N.

MOULD WALL MOVEMENT

The early stages of solidification in a greensand mould are accompanied by a rapid initial effective "shrink" caused by expansion of the mould cavity. Once sufficient thickness of solidified shell has built up, further mould wall movement has no effect on the solidification process. For a typical greensand mould about half the total effective shrink is caused by mould wall movement. To model the effect on riser shrink profile, it is necessary to know the shell thickness at which mould wall movement ceases to affect solidification. Examination of risers in mild steel castings weighing from 15 to 800 pounds has shown that, for a non-sleeved riser, mould wall movement ceased to contribute to the shrinkage cavity profile when the solidified shell in the riser was approx. 0.75 inches thick. This value has been used in the current program. Mould wall movement creates an extra solidification "zone" in the riser, marking a point where the shrinkage (S in equation 1) changes from that caused by solidification shrink plus mould wall movement to a value associated with solidification shrink alone.

HEAT LOSS FROM THE TOP SURFACE OF THE RISER

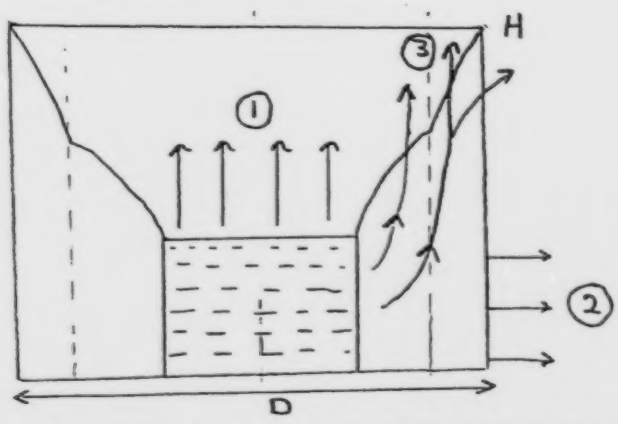


Fig 3. Typical shrink profile in the riser during solidification.

The liquid centre of the riser shown in fig 3 above is losing heat through (1) conduction through the side walls, (2) radiation from the top surface, and (3) conduction from the solidified shell up into the exposed solidified rim. The latter is very difficult to analyse. An equation relating MR with D,H and hot topping procedure has been derived empirically, as follows.

MR = RISER VOL/(SIDE-WALL AREA + B * EFFECTIVE TOP AREA), where B is the surface area alteration factor for the hot topping.

Let the effective top surface area be πR^2 F, where the factor F will depend on the shape of the rim. Now

$$MR = \frac{\pi R^2 H}{2\pi R.H \; + \; B.\pi R^2.F}$$

$$= \frac{H}{4G \; + \; B.F}$$

Empirical observations can now be utilized. For an unsleeved riser with a hot topping surface alteration factor (B) of 0.7 and G = 1, the value for MR that gives the best fit to observed riser shrink profiles is MR = D/5.5. Therefore

$$\frac{D}{5.5} = \frac{D}{4 + 0.7 \cdot F}$$

from which it follows that F = 2.1. Work on risers with G other than 1 showed that F is itself dependent on G. The final relation is

$$MR = \frac{H}{4.G + (1.1 + G) \cdot B}$$

THE EFFECT OF THE RISER/CASTING JUNCTION AREA ON CASTING MODULUS

Let the effective cooling area of the casting subjection to which the riser is attached be AC.

If the bottom surface of the riser is smaller than the top surface of the casting then the cooling surface of the casting is reduced by $\pi.R^2$. Let the actual, final casting modulus be termed MMC. Now

$$MMC = \frac{VC}{AC - \pi R^2}$$

When the bottom surface of the riser completely overlaps the top surface of the casting (SSC),

$$MMC = \frac{VC}{AC - SSC}$$

A problem arises here in that the top surface of the casting is not normally part of the input, and also the condition where the riser overlaps part of the top casting surface is not described by either of the above equations. In CANMET, the casting is assumed for these purposes to be cube-shaped, i.e SSC = AC/6. The expressions used in CANMET are:

$$MMC = \frac{VC}{AC - \pi R^2} \quad \text{if } \pi R^2 < AC/G.$$

$$MMC = \frac{VC}{5/6.AC} \quad \text{if } \pi R^2 > AC/G$$

These expressions are accurate only for cube castings. For less chunky castings, with lower MC, the actual contact area will be less than that given by the expressions. However, rangy castings need smaller risers, the trend is correct, and the inaccuracy introduced is small.

If a riser sleeve is used with hot topping, the actual length of the sleeve must be increased in order to allow for addition of the topping. The depth of hot topping is assumed to be one tenth (1/10) of the riser diameter (see C.F. Corbett, British Foundryman 1974, pp. 106-115).

THE EFFECT OF SUPERHEAT

Shrinkage in the liquid is taken as 1% for each 100°C of superheat. This causes an effective reduction in the riser height equal to

$$0.0001 \times \frac{\text{volume of casting + riser}}{\text{riser cross-sectional area}}$$

This effect is negligible for chunky castings with sand risers, but can become significant for rangy castings or castings with sleeved risers.

JUNCTIONS

On the basis of feeding distances and ease of moulding, the casting is first divided into "sections", each section fed by a single riser. The sections are then in turn divided into "sub-sections" with approximately constant modulus. For example, a casting consisting of a cube located on a plate, fed by a single riser, would be considered to have one section and three sub-sections, one of which is a "junction" (see figure 5).

Moduli for the sub-sections are defined in the usual way, as ratios of volume to cooling surface area. A problem arises here in treating the common areas between sub-sections. These are non-cooling surfaces while both sub-sections are still liquid, and so do not contribute to the moduli at the start of solidification, but the situation is less clear when one of the sub-sections has solidified. In the current calculations, the common area between two sub-sections is assumed non-cooling up to the time when one of the sub-sections solidifies. Thereafter the common area is considered as a cooling surface when calculating the modulus of the unsolidified sub-section. In effect sub-sections are considered to turn into "sand" once they have solidified.

Wlodawer gives empirical expressions for the effective modulus at various types of junction for bars and plates of equal section. In the CANMET program, junctions can be treated through a judicious division between two plates joined perpendicularly. Two possible ways of sub-dividing such a junction are shown in Fig. 4. Clearly, the sub-division shown in Fig 4(a) will predict a riser smaller than that needed, for the

Fig 4. Two ways to divide a junction between perpendicular plates into sub-sections.

heat concentration at the junction is ignored. With sub-division 4(b), however, the sub-section created at the centre of the junction has a high initial modulus, and will solidify very slowly until the other sub-sections are solid. Similarly, T and Y junctions can be sub-divided to allow for the junction effect, Fig 5. Several examples have been analysed, and good correlation with Wlodawer's formulae has been found.

Fig 5. Correct division of T and Y junctions to allow for the heat concentration effect.

III RISER NECK

A rectangular cross-section side riser neck is assumed, with a length 0.3 times the riser diameter and one dimension specified by the user. The other dimension is set to a value such that the neck modulus is 1.1 times the casting modulus in its last solidification zone.

IV GATING SYSTEM

The gating system is based on the paper by R.M. Kotschi in "Gating and Risering: State of the Art," Steel Founders' Society, 1982, pp. 51-73.

The pouring time of the gating system as a function of casting weight W in pounds is taken from Lange and Bukowski, "Pouring Times for Steel Castings," U.S. naval Research Laboratory Report, 1958:

$$t_p = (1.733 - 0.267 \ln W)W^{1/2} \text{ seconds}$$

The fluidity of the steel as a function of the pouring temperature T in degrees fahrenheit is taken from Taylor, Rominski and Briggs, Trans AFS, Vol. 49, pp. 1-93, 1941 and from Lillieqvist, Trans AFS, Vol. 58, p. 261, 1950:

$$FL = .07T - 178 \text{ inches}$$

The runner friction factor is set to 0.87. The net area of the sprue base or the runner choke (whichever is the smallest cross-section), according to Kotschi's formulation, is then:

$$A_s = \frac{1.65 \quad V_c}{t_p \; FL \quad P} \text{ square inches}$$

where the pressure head factor P is defined in terms of the sprue height, S, the pattern height in the cope, C, and the pattern depth in the drag, D:

$$P = S - 0.5\ C^2/(C + D)$$

If the gate:runner:sprue area ratios are set to G:R:1, then it follows that the net gate area for the casting is

$$A_G = G\ A_s$$

For small castings, the volume of the gating system may be as high as 10% of the casting volume; for very large castings it may be under 2%. In addition, rangy castings will require larger gating systems than chunky castings. If we use Ruddle's definition of a ranginess parameter:

$$RG = \frac{\text{surface area of casting}}{\text{surface area of cube of volume } V_c} = A_c/6\ V_c^{2/3}$$

then the gating system volume for a typical casting is calculated from the empirical formula:

$$V_G/V_c = (.268 - .146Z + .03Z^2 - .0021Z^3)\ (1 + 2.3 \log_{10} RG),\ RG > 1.0$$

$$= (.268 - .146Z + .03Z^2 - .0021Z^3),\ RG \leq 1.0$$

where $Z = \log_{10}$ (Weight of casting in lb.)

Since the fluidity of the steel depends on alloy composition and mold material, and the gate area and gating volume depend on the specific gating system design, the user may wish to insert his own formulae into the program.

CANMET RISERING PROGRAMME

USER INSTRUCTIONS

I OVERVIEW

The CANMET Risering Programme is designed as an aid to the foundry engineer to design a risering and gating system for a steel casting. It assumes no special computer knowledge on your part, and in fact ignores illegal characters that you may accidentally type in.

You may use the programme to create a printed table of possible feeding distances for the various sections of the casting, in order to help you decide the number and placement of risers and chills.

Then for each separately risered section, you can use the programme to describe the volume and cooling surface area of each sub-section, and to calculate the optimum size of the riser for various riser types and size constraints. The programme will show you the shape of the riser shrink profile for the optimum riser size, and for your chosen size. For each riser type, you can print out a section/riser summary and/or a summary of section costs in order to determine the most cost-effective approach.

When you have decided on a final design for a given riser, you must save the section/riser data on magnetic disk before going on to the next section. Then, when all section risers have been designed, you can use the program to design a gating system and print out a cost summary for the casting as a whole.

Since you can save your data on magnetic disk at any time, you may interrupt a casting design and continue the analysis later without starting from scratch.

CANMET RISERING PROGRAMME

II DISK USAGE

All of the programs necessary to run the CANMET Risering Programme on stored on a 5 1/4" magnetic disk which we shall call the Master Program Disk. This disk is not copy-protected, so that you can make back-up copies with no difficulty. We recommend that you make at least two copies of the Master Program Disk and put the original in a safe place. Refer to the manual which came with your disk drive, or the Disk Operating System manual for details on how to make copies of your disks.

In order to run the programme, you must place the Master Program Disk into drive # 1, close the door, and turn the computer power on. A title and disclaimer will appear on the screen after a few seconds, along with a message to press the space bar to continue. When you press the space bar, a preliminary menu will allow you to go directly to the INSTRUCTIONS program, the CREATE/EDIT SLEEVES program, or the CANMET MAIN PROGRAM (See program descriptions below).

The Master Program Disk, or a copy of it, must remain in drive # 1 at all times while you are running the programme, since several of the menu options result in loading and running another program. The CANMET Risering Programme is set up to store any data files to the disk in drive # 1. There is room on the Master Program Disk for about 28,000 characters of data.

If you have a second disk drive, you can store the data files on formatted disks in drive # 2 while keeping the Master Program Disk in drive # 1. In order to do this, you must stop the program and type:

```
LOAD HELLO
290 DD=2
UNLOCK HELLO
SAVE HELLO
LOCK HELLO
```

With this change in line 290 of the HELLO program, all data files will automatically be loaded from, or written to, the disk in drive # 2. A freshly formatted disk has a storage capacity of about 120,000 characters. See your Disk Operating System manual for instructions on how to format data disks: it cannot presently be done from within the programme.

You should keep a supply of formatted disks (or copies of the Master Program Disk) available for storage of new data in case your current data disk fills up. And don't forget to make back-up copies of any data disks that you use!

A brief description of each program on the Master Program Disk follows:

RAMDISK: This program is called from the HELLO program to format the upper 16K of your Apple's 64K of RAM as if it were a small disk with volume #222. This "disk" space is then used to store some utilit, files as well as scratch files for passing selected variables from

one program to another.

CANMET SUPPORT: The program is called from the HELLO program, and contains several short machine language utilities, including a tone generator and a text screen dump routine.

HGR TEXT WRITER: This program is stored in the "RAMDISK" space, and is used to draw text characters on the high resolution graphics screen from within the CASTING SHAPE/SIZE and RISER SIZE/NECK programs.

RECTANGULAR SHAPES: This is a "shape-table" file, stored in the "RAMDISK" space, and used to draw 3-dimensional rectangular shapes in CASTING SHAPE/SIZE.

ANNULAR SHAPES: This is a "shape-table" file, stored in the "RAMDISK" space, and used to draw 3-dimensional annular shapes in CASTING SHAPE/SIZE.

QUICK-DRAW: This program reads data from the Apple Graphics Tablet and stores it in arrays for use by CASTING SHAPE/SIZE. It requires that the file TAB.INFORMATION be written to the Master Program Disk by the Graphics Tablet software.

HELLO: This program is automatically run when the Master Program Disk is in drive # 1 and the power is turned on. It sets default values for a number of parameters, formats the "RAMDISK" space in memory and transfers files from disk to that space, presents a disclaimer notice, and allows branching directly to the INSTRUCTIONS or CREATE/EDIT SLEEVES program.

INSTRUCTIONS: This program presents brief outline of the major menu options and describes a recommended procedure for riser design using the CANMET risering system.

CREATE/EDIT SLEEVES: You use this program to create or edit a data file containing information on riser sleeves commonly in stock in your foundry. It is not an inventory program and will not tell you whether you have any sleeves of a given size left. The program RISER SIZE/NECK will read the data file created here in order to help you decide on the optimum riser design.

CANMET MAIN PROGRAM: Contains the main menu, and program code for the menu options: Customer/casting info, Feeding Distance, Gating System, Cost Analysis, and Quit/Store to Disk.

CASTING SHAPE/SIZE: Uses the high resolution graphics screen to help you describe the various sub-sections (main section and appendages) to be fed by a given riser.

RISER SIZE/NECK: Calculates the optimum riser size for the riser type and/or restrictions that you specify, and displays the riser shrink profile on the high resolution graphics screen.

Other file names on the Master Program Disk are dummy names used for titling only - they do not take up any space on the disk.

III MENU OPTIONS

1. INSTRUCTIONS:

Runs a program to present you with a brief summary of each option in the main menu with a recommended order of selection. You control the display of the text by means of 4 keystroke commands shown at the bottom of the screen.

2. CUSTOMER/CASTING INFO:

Here you enter your name, the customer name and address, the purchase order #, and the date of the analysis. Casting information consists of a qualitative description of the casting and the pouring temperature, melting point, density, and shrinkage of the steel, and the density of hot topping and top insulation (if any).

The solidification shrinkage of the steel is selected by the program, but can be over-ridden at your discretion. You can choose to work in imperial or metric units, and to switch units at any time. After each 'page' of information is presented you are given a chance to change any items on the page. When changing an item of customer/casting information, press the <RETURN> key at the beginning of the entry field to leave a line unchanged. Typing any characters before <RETURN> will erase the previous entry.

You can select the molding materials and molding process from menus. (with a default to green silica sand). Your choice will affect the feeding distance and mold wall movement allowance in riser size calculations.

The customer/casting information or section/riser data may be loaded from a disk file (previously generated with Option 8) and may be changed at any time with Option 2.

3. FEEDING DISTANCE:

Allows you to estimate the sound feeding distance from the riser for a given casting section, depending on the effective thickness and width of the section, and whether chills or a taper (padding) are used.

The sound feeding distances are given from the edge of the riser to an end or to the edge of a drag chill (or to the maximum sound distance for lateral feeding without chill). A preliminary estimate of the riser size is also made for comparison.

You can also print out a table of all feeding distances for each specified section size.

4. CASTING SHAPE/SIZE

A series of options by which you can describe the volume and surface area of a casting section to be fed by a single riser. You can describe the section as a sum of elementary shapes, which are presented using 3-dimensional high-resolution graphics these shapes can be used to specify voids within the casting, non-cooling surfaces, and chill areas as well.

Since a riser may feed several sub-sections of differing modulus, you may label and separately describe sub-sections to be added together in Option 5.

Complex castings with uniform cross-section may be described with the help of an Apple Graphics Tablet, if you have one. The QUICK-DRAW utility for the Tablet is included on the Master Program Disk, but this option also requires that you have put the text file TAB.INFORMATION (with calibration parameters for your Tablet) on the Master Disk.

You must draw the cross-sectional profile of the casting in one unbroken line; you will be given the opportunity to re-draw the profile before calculation of the cross-sectional area.

5. RISER SIZE/NECK:

This option cannot be entered until the CASTING SHAPE/SIZE option has been used. If it has, the sub-sections are summed, the modulus of each is calculated and you will be asked for the sub-section number on which the riser will be placed. You may specify riser type from a menu of seven choices of cylindrical risers.

If you choose a sleeved riser you will be asked if you want to select a sleeve from stock (via a data file on disk). Each record contains the inner diameter, length the apparent surface alteration factor (ASAF) of the sleeve insulation, the cost of the sleeve, and an indication of whether the sleeve will be cut to size.

You may search the disk file for a particular sleeve diameter or scan the file to obtain a list of all potentially usable sleeves for the section being analysed. Sleeves of the same diameter but differing lengths are distinguished by differences in the second decimal digit of the recorded sleeve diameter (see option 8).

If a sleeve is not to be selected from a disk file, you will be asked for the ASAF and cost data for the sleeve. Then you must specify any restrictions on height or diameter of the riser in order to obtain the optimum size. If there are no restrictions, you may simply specify the height/diameter ratio.

Once a riser is specified, a standard formula riser neck may be calculated by the program and altered to your specification. You may also produce a printout showing a detailed summary of the sub-section and riser parameters for your permanent files.

6. GATING SYSTEM:

This section is intended to help you design a gating system for the casting and to provide additional data for a complete cost analysis. You must type in the ratio of net gate area/sprue area, sprue height, pattern height and depth, total number of gates, and number of gates attached to the casting. (Some gates may be attached to risers.)

If the net volume and area of the casting have not been summed, the program will ask whether all sections have been risered. If your answer is yes, it will read the appropriate section/riser data files from disk in order to add up the net casting volume and area, the net riser and neck volumes, and other parameters necessary for later cost analysis. Then the program will estimate the required pouring time and the net weight and gate area of the system using a standard formula. You may substitute different values at your discretion.

7. COST ANALYSIS:

Here you can enter pertinent cost information, such as cost of molten metal/unit wt, cut-off costs/unit area, etc., or load them from a previously defined disk file.

If you have completed Options 4 and 5 for a given risered section, you produce a screen display or a print-out of its costs. Option 6 is necessary for a net cost analysis. You can return to Option 5 to change riser type/neck parameters, then re-enter the cost analysis option in order to compare the cost of various possibilities. Comparison can only be made via the printouts.

8. QUIT/STORE FILES ON DISK:

You can use this option to store on the disk the customer/casting information (including gating system data), or the casting section/riser data (sub-section volume and surface areas, and riser/ neck data).

The names of these files are assigned by the program, using the first 20 characters of the purchase order # as part of the file name in order to avoid accidental over-writing of previously stored data from other castings. You can save the cost information entered in Option 7, using a disk file name of your choice.

You can also create and make changes in a disk file of insulating sleeves which are normally kept in stock in your foundry. The size of each sleeve may be specified using either imperial or metric units. Sleeves of the same diameter but different length should be assigned nominal diameters which differ by at least 0.01 inches.

Using this option, you can interrupt a session as necessary without losing information. The sign-off message for the program also tells you how to immediately re-enter the program without losing data, in case you quit without storing your data on disk.

IV RECOMMENDED PROCEDURE:

After entering the data required in CUSTOMER/CASTING INFO, you will normally reduce the casting to a composite of elementary shapes (bars, plates, cylinders, etc.) and will use the FEEDING DISTANCE option to print out a table of possible feeding lengths within each section. For parasitic sections, unless more accurate data is available, you should assume the feeding distance will be that of a section fed directly by a riser.

Next you will check the casting for hot spots, and plan to place a riser or a chill at each of them, noting that placement of a chill will mark a division between separately risered sections. You will then place supplementary risers by making use of the feeding distance table already in hand and using block chills, taper chills, or padding as required.

Once you have decided on the location of each riser, you must use the CASTING SHAPE/SIZE option to determine the volume, surface area, junction areas, and chill area for the (sub-)sections to be fed by a given riser. Then the RISER SIZE/NECK option will calculate the best parameters for the riser configuration of your choice. A new section and riser may be set up after storing the section/riser data for the section whose analysis is finished. Any section may be re-analyzed by loading its section/riser data file in the CUSTOMER/CASTING INFO option.

You will normally enter the COST ANALYSIS calculation for each trial riser/neck configuration for a given section in order to find the lowest net cost for an effective risering system for his casting.

In order to obtain a cost analysis for the entire casting, you must enter the GATING SYSTEM option to sum the risered sections and define the parameters of the gating system for the casting. If you want to save your gating system parameters on disk, you must save the customer/casting information after completing the GATING SYSTEM option.

CANMET RISERING PROGRAMME
TUTORIAL SESSION

In this section, we will design a risering system for the valve housing shown in figure 5.1, illustrating the operation of the program in detail and making use of a part of the CANMET SUPPORT program which copies the text screen to the printer when the 'CTRL' key and the 'P' key are pressed at the same time.

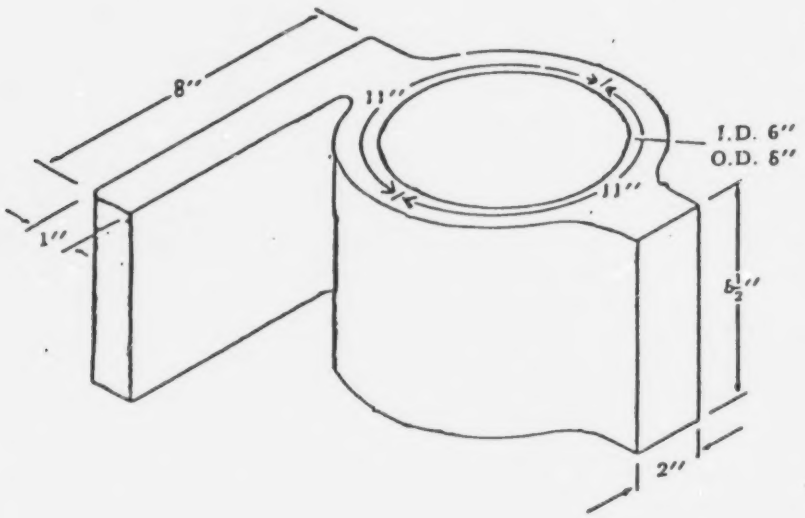


Figure 6: Steel valve housing for which a risering system is to be designed

Following the User Instructions of the previous section, we place the Master Program Disk into drive #1, close the drive door, and turn on the computer power. After a few seconds the title and disclaimer appear. Then after a few more seconds and several disk accesses, we see the line "PRESS ANY KEY TO START". We press the space bar, and see a short menu:

```
CANMET RISERING PROGRAM, V2.1

DESIGNED BY QUEEN'S UNIVERSITY STAFF
  IN COLLABORATION WITH PMRL/OTTAWA



THIS SOFTWARE HAS BEEN THOROUGHLY TESTED
PRIOR TO RELEASE. HOWEVER, CANMET MAKES
NO WARRANTY, EXPRESS OR IMPLIED, OF ITS
FITNESS FOR ANY PARTICULAR PURPOSE.

IN NO EVENT WILL QUEEN'S UNIVERSITY OR
CANMET BE LIABLE FOR DIRECT, INDIRECT,
OR CONSEQUENTIAL DAMAGES RESULTING FROM
ANY DEFECT THEREIN.



   PRESS SPACE BAR TO START...
```

```
CANMET RISERING PROGRAM, V2.1

DESIGNED BY QUEEN'S UNIVERSITY STAFF
  IN COLLABORATION WITH PMRL/OTTAWA



 1. RUN THE RISER PROGRAM

 2. CREATE/EDIT RISER SLEEVE FILE

 3. LOOK AT INSTRUCTIONS

 4. QUIT


 WHICH?  PRESS A NUMBER KEY...
```

In this case, we want to go directly to the riser program, so we press the key "1". The computer does not wait for us to press the "RETURN" key, but immediately starts to load and run the next program. Throughout the program, menu choices and choices requiring a single key press do not require us to also press RETURN. in fact, the program is also set to consider any key other than "Y" to mean NO. If the program asks us to type in something that may take more than one character, it expects us to terminate our input with the "RETURN" key.

Now that the main program is loaded in, we see the main menu: Note that we can go to the INSTRUCTIONS module from here or from the preliminary menu.

```
MAIN MENU FOR CANMET RISERING:


 1. INSTRUCTIONS

 2. CUSTOMER/CASTING INFO

 3. FEEDING DISTANCE

 4. CASTING SHAPE/SIZE

 5. RISER SIZE/NECK

 6. GATING SYSTEM

 7. COST ANALYSIS

 8. QUIT/STORE FILES ON DISK


WHICH?  PRESS A NUMBER KEY...
```

The first option we want from the main menu is #2, so that we can fill in some preliminary information. When we press the "2" key, the program will ask us whether we want to get the information from disk. In this case, we have not previously stored any Customer/Casting Info on disk so we press the "N" key. If we had answered YES, we would have been asked for a purchase order number - that number is used as part of the file name to avoid duplication of names on the disk.

The first screen of Customer/Casting Info requires us to type in various pieces of information for later use on printed reports. The second screen presents us with a series of default values. In both cases, we are given the opportunity to change the data shown before going on. Our screens will look like this:

```
CUSTOMER/CASTING INFORMATION


CUSTOMER NAME:  UNIVERSAL VALVES, LTD.

CUSTOMER ADDRESS:  2500 PRINCESS ST.

CUSTOMER CITY/PROV:  KINGSTON, ONTARIO
K7L 3N6

CASTING DESCRIPTION:  6" INNER DIAM VALV
E HOUSING

PURCHASE ORDER #:  123

TODAY'S DATE:  28 MARCH, 1984

YOUR NAME:  JOHN DOE

CHANGE ANY OF THE ABOVE?  Y/N
```

```
CUSTOMER/CASTING INFORMATION


UNITS? IMPERIAL OR METRIC:  I

POURING TEMPERATURE (F):  2912

SOLID'N TEMPERATURE (F):  2760

FEED METAL SHRINKAGE (%):  4


HOT TOPPING DENSITY (LB/CU.IN):  .071

TOP INSUL'N DENSITY (LB/CU.IN):  .0010

CHANGE ANY OF THE ABOVE?  Y/N
```

The next screen of Customer/Casting Info shows us the default molding material/process: Green Silicon Sand, and asks whether we want to change it. We will press the "N" key, but if we had pressed the "Y" key, we would see the following two multiple-choice screens:

```
CUSTOMER/CASTING INFORMATION


  CHOICE OF MOLDING MATERIALS:

     1. SILICA SAND

     2. OLIVINE SAND

     3. CHROMITE SAND

     4. ZIRCON SAND

  WHICH?  PRESS A NUMBER KEY...
```

```
CUSTOMER/CASTING INFORMATION


  CHOICE OF MOLDING PROCESS:

     1. GREEN

     2. DRY

     3. NOBAKE

     4. SHELL

  WHICH?  PRESS A NUMBER KEY...
```

Finally, we are asked whether to get section/riser data from disk. This is our first run, so we press the "N" key and are sent back to the main menu.

We need feeding distances to decide on riser and chill placement, so we choose option 3 next. When we enter the section thickness and width of the first section, we are presented with a caution, then a menu of choices for the display of feeding distances for that section:

```
FEEDING DISTANCE

EFFECTIVE SECTION THICKNESS (IN): 1

EFFECTIVE SECTION WIDTH      (IN): 5.5

TREAT THE FOLLOWING VALUES WITH CAUTION

GATING HAS A SIGNIFICANT EFFECT ON

FEEDING DISTANCE FOR THICKNESS < 2 IN

     PRESS SPACE BAR TO CONTINUE...
```

```
FEEDING DISTANCE

1. NO CHILLS OR TAPER

2. END OR DRAG CHILLS

3. TAPERED SECTION (PADDING)

4. NEW SECTION SIZE

5. PRINT SIZE/DISTANCE TABLE ENTRY

6. RETURN TO MAIN MENU

WHICH?  PRESS A NUMBER KEY...
```

We want to print a table of feeding distances, so we will alternate between option 5, (to print a line of the table) and option 4 (to enter a new section size, by going back to the previous screen) until we have all the information we need. The feeding distance table, including a few dimensions not found in our casting, is shown below:

FEEDING DISTANCE TABLE (IN) FOR LOW CARBON STEEL IN GREEN SILICA SAND

SECTION SIZE		NO CHILLS		END OR DRAG CHILLS				TAPERED SECTION	
THICKNESS	WIDTH	END DISTANCE	LATERAL DISTANCE	END DISTANCE	LATERAL DISTANCE	CHILL THICKNESS	DRAG CHILL LENGTH	REQUIRED SLOPE	UNTAPERED END LENGTH
1.00	5.50	5.5	2.1	6.4	5.8	0.6	4.6	0.032	2.7
2.00	5.50	10.9	4.1	12.7	11.5	1.2	6.6	0.054	5.1
3.00	5.50	13.9	5.5	17.2	14.5	1.8	8.7	0.104	6.6
3.00	3.00	9.5	5.0	11.6	9.7	1.8	6.8	0.145	4.7

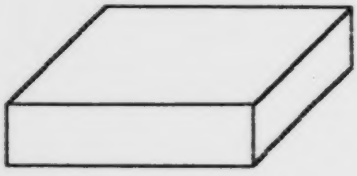
Comparison of the feeding distances and the drawing of the casting suggests that we should use two risers and three chills to produce a sound casting. The risers would be placed on the hot spots on opposite sides of the valve cylinder. The chills would be placed halfway between the risers on the sides of the valve cylinder, and at the end of the flange. Having made these decisions, we return to the main menu and choose option 4: CASTING SHAPE/SIZE.

We have to wait while the programme stores variables and loads and runs the next program. Then we see the menu for CASTING SHAPE/SIZE:

```
CASTING SHAPE/SIZE:
SHAPE MENU

1. SET SUB-SECTION NUMBER

2. RECTANGULAR SHAPES/PYRAMID

3. CYLINDER/TORUS/SPHERE

4. COMPLEX CROSS-SECTION

5. CALCULATE RISER SIZE/NECK

6. RETURN TO MAIN MENU

WHICH?  PRESS A NUMBER KEY...
```

Our first riser will be feeding three sub-sections: the flange half of the valve cylinder, and the junction connecting them. To define the flange first, we choose option 2 and see a three-dimensional drawing of a rectangular prism and a short menu at the bottom of the screen:

```
A) RIGHT-ANGLE PRISM
```



```
1. SHOW NEXT SHAPE
2. USE THIS SHAPE
3. RETURN TO SHAPE MENU
                    WHICH?
```

This is the shape we want, so we press the "2" key and type in the three dimensions of the flange when asked. As we type in each dimension, it is shown in the appropriate place on the drawing. Then we are given a chance to change any of the dimensions.

If the dimensions are OK we are asked whether to add or subtract this section from the casting we would subtract if the shape represented a core.

We press the "A" key for ADD, then we must specify how many identical shapes are being fed by the same riser. We have only one flange, so we press "I" and then the "RETURN" key.

Now we are asked if there are any non-cooling areas on this shape. There are, so we press the "Y" key and see yet another menu.

```
A) RIGHT-ANGLE PRISM

                    H= 6
                              L= 1
                    B= 5.5

VOLUME (CU.IN) = 33
SURFACE AREA (SQ.IN) = 89
ADD TO OR SUBTRACT FROM SECTION?  A
HOW MANY OF THIS SIZE/SHAPE? 1
ANY NON-COOLING AREAS? Y/N  Y
```

```
NON-COOLING AREA
================          NET VOL. = 33
                          NET AREA = 89
1. RECTANGULAR
2. CIRCULAR
3. RING SHAPE
4. ELLIPTICAL
5. TRIANGULAR
6. COMPLEX
7. QUIT NON-COOLING AREAS

WHICH?  PRESS A NUMBER KEY...
```

Our non-cooling area is rectangular in shape, about 1 x 5.5 inches. Choosing shape 1 from the menu, we type in these dimensions when asked.

Next the program wants to know whether the non-cooling area is attached to another sub-section fed by the same riser. It is attached to the "junction", but we will say NO for now and fix it up later. When asked how many of these rectangular 1 x 5.5 non-cooling areas there are, we type 1, and press the "RETURN" key. The display of the net cooling area at the top right of the screen is then adjusted for our non-cooling area.

We choose option 7 from this menu to leave, but find that we have to repeat the process (except for the question about attachment to another sub-section) if there are any chilled areas.

The chill at the end of the flange has a rectangular contact area of 1 x 5.5 inches. After we enter this information and again choose option 7 to leave, we find ourselves back in the Shape Menu.

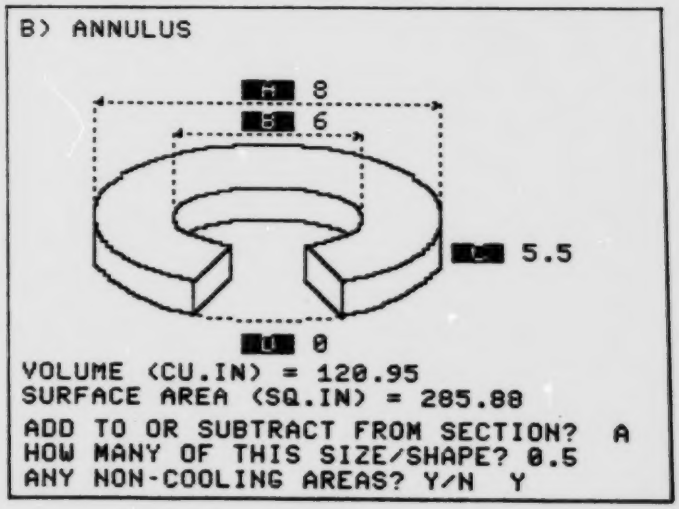
At this point, we have described only one of our sub-sections. In order to describe the next sub-section, we must choose option 1: Set Sub-Section Number.

```
CASTING SHAPE/SIZE:

SUB-SECTIONS FED BY THE SAME RISER
SHOULD BE SEPARATELY IDENTIFIED WHEN
THEY HAVE SIGNIFICANTLY DIFFERENT
MODULUS VALUES.

CURRENT SUB-SECTION #  1

START A NEW SUB-SECTION? Y/N Y

NEW SUB-SECTION NUMBER (0-9):
```

Here we find that we have been describing sub-section 1, so we set the sub-section number to 2 for the valve cylinder, and find ourselves back at the Shape Menu again. If we had made a mistake in the dimensions of the flange, we could have chosen to start a <u>new</u> sub-section 1 to start over.

The valve cylinder is a section of an annulus, so we choose option 3 from the Shape Menu, and press the "1" key until we see shape B) Annulus. We press the "2" key and are prompted to type in the outer and inner diameters and the length of the annulus. Then we are shown the values of the inner and outer circumference and asked for the opening angle of the annular section in terms of the "missing" outer circumference (dimension D in the figure).

Since this sub-section is exactly half of an annulus, we set the dimension D to zero and specify that a fraction 0.5 of this shape be fed by the riser.



We must specify a non-cooling area 2 x 5.5 inches for the valve section, but this time we admit that the non-cooling area is attached to another sub-section: we press the "3" key when asked for the connected sub-section number, since we have decided to call the junction sub-section 3.

We have two chills attached to this sub-section, but they are also attached to another, separately risered, section. Therefore we should describe only the half of each chill which is in contact with this particular sub-section. From the feeding distance table, we see that the maximum drag chill length between risers is 4.6 inches, so we will assume a 4" x 5.5" chill on either side of the valve. Then we have two 2" x 5.5" chills effectively in contact with this sub-section.

The same procedure is used for sub-section 3: this ju;nction section is a rectangular prism 5.5 inches long, 2 inches wide, and 1 inch thick. It has two rectangular non-cooling areas: an area 5.5 x 1 inch attached to sub-section 1 and an area 5.5 x 2 inches attached to sub-section 2.

Having finished our description of the three sub-sections, we return to the Shape Menu and select option 5 to calculate the riser size. But first the programme checks our junction areas for consistency and catches our earlier carelessness in describing the noncooling area of subsection 1. The computer sees two different junction areas between sub-sections 1 and 3 where there should be o ly one, so it shows us both and asks us to choose.

```
        CASTING SHAPE/SIZE:


INCONSISTENT JUNCTION AREAS
   BETWEEN SUB-SECTIONS  3  AND  1


   1. SET AREA =  5.5  SQ.IN

   2. SET AREA =  0  SQ.IN

   3. RETURN TO SHAPE MENU


WHICH?  PRESS A NUMBER KEY...
```

```
                RISER SIZE/NECK

   SUB-     WEIGHT    MODULUS
  SECTION    (LB)       (IN)

     1        9.3       0.37
     2       17.1       0.39
     3        3.1       0.54

   THERE ARE  3  SUB-SECTIONS.

ON WHICH SUB-SECTION
WILL THE RISER BE PLACED? 3
```

We choose by pressing the "1" key, and are rewarded with a summary of subsection weights and moduli, and a question about where to place the riser. If we press the "RETURN" key, the program will assume that the riser is on the sub-section with the largest modulus.

With the decision on riser placement, we are finally finished with CASTING SHAPE/ SIZE for this section, and can move on to RISER SIZE/NECK to set up the riser design.

After a few seconds of program loading, we are presented with the Riser Type menu. On choosing type 5: Sand Riser with Hot Topping, we see a sub-menu in which we can specify constraints on the riser shape:

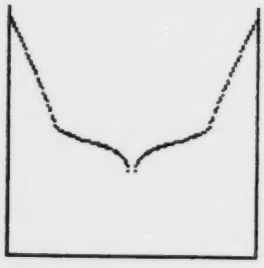
```
RISER SIZE/NECK

1. SLEEVE WITH HOT TOPPING
2. SLEEVE WITH INSULATED TOP
3. SLEEVED BLIND RISER
4. SLEEVE WITH OPEN TOP
5. SAND RISER WITH HOT TOPPING
6. BLIND SAND RISER
7. SAND RISER WITH OPEN TOP
8. RETURN TO MAIN MENU

WHICH?  PRESS A NUMBER KEY...
```

```
RISER SIZE/NECK

SAND RISER WITH HOT TOPPING
1. RISER WITH FIXED DIAMETER
2. RISER WITH FIXED HEIGHT
3. RISER WITH FIXED HT/DIAM RATIO
4. SET RISER NECK
5. PRINT LAST RISER ANALYSIS
6. RETURN TO RISER TYPE MENU
7. RETURN TO MAIN MENU

WHICH?  PRESS A NUMBER KEY...
```

On the riser sub-menu, we will select option 3 and specify a value of 1.0 for the height/diameter of the liquid in the riser. After a few seconds of calculating the program presents us with a screen showing the optimum riser dimensions and weight of hot topping required. The initial height of liquid in the riser is 3.5 inches, but the actual riser height is set at 3.8 inches to make room for the hot topping.

```
        RISER SIZE/NECK


  SAND RISER WITH HOT TOPPING


APPARENT SURFACE ALTERATION FACTOR:
                              TOP = .7
                             SIDE = 1

HEIGHT/DIAMETER : 1

RISER  DIAM (IN): 3.5
RISER   HT  (IN): 3.8

SECTION YIELD(%): 76

HOT TOPPING (LB): .231



DO YOU WANT TO SEE
    THE RISER SHRINK PROFILE? Y/N
```

The next screen shows the riser shrink profile for the computer-selected "safe" riser. There appears to be a good margin of safety, but the central sink can be fairly deep.



```
SHRINK PROFILE FOR:
     RISER DIAMETER = 3.5 IN
            HEIGHT = 3.8 IN

DO YOU WISH TO DISPLAY THE RISER SHRINK
  PROFILE FOR A DIFFERENT DIAMETER? Y/N
```

The riser dimensions calculated by the program are recommendations only - we can specify a different diameter and let the program calculate and display a new shrink profile. The safety factor for the riser is under our control For the purposes of this tutorial, we will accept the program's figures and return to the Riser Sub-Menu to set the riser neck dimensions.

```
          RISER SIZE/NECK

   SAND RISER WITH HOT TOPPING

          SIDE NECK DESIGN



NECK LENGTH (IN):  1

NECK DIMENSION(IN): 1.5

NECK SIZE(IN): 1.5  BY  1.4



CHANGE ANY OF THE ABOVE?  Y/N
```

The riser neck is assumed to be a rectangular side neck with a default length of 0.3 times the riser diameter and a modulus 1.1 times that of the casting section. We can choose the actual length and one dimension of the neck.

Now that we have a riser design and a neck design, we can choose option 5 of the Riser Sub-Menu to obtain a summary on the printer. Before the summary is printed, we must identify the riser with a number from 0 to 9, this number is used on the printout and as part of the file name when the section/riser data is stored as a disk file. The section summary is shown on the next page.

SECTION SUMMARY FOR RISER # 1

BY: JOHN DOE
DATE: 28 MARCH, 1984

FOR: UNIVERSAL VALVES, LTD.
2500 PRINCESS ST.
KINGSTON, ONTARIO K7L 3N6

PURCHASE ORDER #: 123
CASTING DESCRIPTION: 6" INNER DIAM VALVE HOUSING

USING LOW ALLOY OR CARBON STEEL AT A POURING TEMPERATURE OF 2912 F

MOLDING MATERIAL: GREEN SILICA SAND

SUB SECTION	WEIGHT (LB)	VOLUME (CU.IN)	AREA (SQ.IN)	MODULUS (IN)	# CHILLS	CHILL AREA
1	9.3	33.0	89.0	0.4	1	5.5
2	17.1	60.5	153.9	0.4	2	22.0
3	3.1	11.0	20.5	0.5	0	0.0
SUMS:	29.6	104.5	263.4	0.4	3	27.5

RISER TYPE: SAND RISER WITH HOT TOPPING /NECK

APPARENT SURFACE ALTERATION FACTOR, TOP: .7
SIDE: 1

RISER HEIGHT/DIAMETER: 1
DIAMETER (IN): 3.5
RISER HEIGHT (IN): 3.8

RISER WEIGHT (LB): 9.2
SECTION YIELD (%): 71

NECK DIMENSIONS (IN): 1.5 BY 1.4
NECK LENGTH (IN): 1
NECK WEIGHT (LB): .6

HOT TOPPING WEIGHT (LB): .23

When we choose to return to the main menu after setting a riser/neck design, we are asked how many risers of this design will be used. In this case there is only one. However, a large symmetric asting might be broken into several identical sections, each of which requires its own riser

We again wait a few seconds for program loading, and see our old friend, the Main Menu. Being interested in costs, we select option 7 to get the Cost Analysis Menu, and option 1 of that menu to enter cost data. If we have a data file for costs, the values can be loaded in from disk and presented on the next screen; if not, we will have to type them in one at a time. As with customer/casting info, we can readily change any of the values shown on the screen.

```
                COST ANALYSIS


    1. ENTER/CHANGE COST DATA

    2. SHOW COSTS FOR CURRENT RISER

    3. SHOW NET COST ANALYSIS

    4. PRINT COSTS FOR CURRENT RISER

    5. PRINT NET COST ANALYSIS

    6. RETURN TO MAIN MENU

WHICH?  PRESS A NUMBER KEY...
```

```
                COST ANALYSIS


COST OF MOLTEN METAL   ($/LB):     .5

CREDIT FOR SCRAP METAL ($/LB):     .15


COST OF HOT TOPPING    ($/LB):     .2

COST OF TOP INSULATION ($/LB):     .1


RISER/GATE REMOVAL     ($/SQ.IN): .15

REMOVAL OF CHILLS      ($/SQ.IN): .1

GRINDING OFF PADS      ($/CU.IN): .4


CHANGE ANY OF THE ABOVE?  Y/N
```

The Cost Analysis Menu gives us a choice of a brief summary of costs on the video screenm or a more detailed summary on the printer. A sample of each is shown here. We cannot yet do a cumulative cost analysis, since it requires the summation of all risered sections in the gating calculation option.

```
COST ANALYSIS  BY: JOHN DOE
--> SECTION    FOR: UNIVERSAL VALVES, LTD

TYPE:  SAND RISER WITH HOT TOPPING /NECK
MOLDING MATERIAL: GREEN SILICA SAND


MOLTEN METAL:          39 LB     $  19.69

R/G CUTOFF:             2 SQ.IN  $   0.31

CHILL REMOVAL:         27 SQ.IN  $   2.75

HOT TOPPING:          .23 LB     $   0.05

TOP INSULATION:

RISER SLEEVE:

SCRAP CREDIT:           7 LB     $  -1.16
                                   ========
28 MARCH, 1984                NET: $  21.64

      PRESS SPACE BAR TO CONTINUE...
```

COST ANALYSIS FOR SECTION NO. 1

BY: JOHN DOE
DATE: 28 MARCH, 1984

FOR: UNIVERSAL VALVES, LTD.
2500 PRINCESS ST.
KINGSTON, ONTARIO K7L 3N6

PURCHASE ORDER #: 123
CASTING DESCRIPTION: 6" INNER DIAM VALVE HOUSING

USING LOW ALLOY OR CARBON STEEL AT A POURING TEMPERATURE OF 2912 F

MOLDING MATERIAL: GREEN SILICA SAND

RISER TYPE: SAND RISER WITH HOT TOPPING /NECK

MOLTEN METAL.....	39 LB	$	19.69
RISER CUTOFF.....	2.1 SQ.IN	$	0.31
CHILL REMOVAL.....	27.5 SQ.IN	$	2.75
HOT TOPPING.....	0.23 LB	$	0.05
TOP INSULATION.....			
RISER SLEEVES.....			
SCRAP CREDIT.....	7 LB	$	-1.16
NET COSTS.....		$	21.64

DENSITY: .071 LB/CU.IN

WEIGHT OF SECTION: 29 LB
WEIGHT OF RISER/NECK: 9 LB

SECTION YIELD: 75.1 %

Perhaps it is time to save some of this data and analysis to disk files. In order to do this, we return to the Main Menu, and choose option 8: QUIT/STORE TO DISK.

```
QUIT/STORE FILES ON DISK

  1. SAVE CUSTOMER/CASTING INFO
  2. SAVE COST INFO
  3. SAVE SECTION/RISER DATA
  4. CREATE/EDIT RISER SLEEVE FILE
  5. SHOW CATALOG OF DISK
  6. RETURN TO MAIN MENU
  7. QUIT PROGRAM

WHICH?  PRESS A NUMBER KEY...
```

```
STORE SECTION/RISER DATA

THE SECTION/RISER DATA FILE:

DATA1/123

HAS BEEN SAVED TO DISK.

PRESS SPACE BAR TO CONTINUE...
```

First we will save the section/riser data, by choosing option 3. Since we have already assigned a number to the riser design, and a purchase order # was entered into the CUSTOMER/CASTING INFO section, the program will assign the file name automatically. The confirmation screen is shown only after the data is successfully saved. When asked whether to zero the section variables, we will respond with the "N" key.

The same procedure is followed to save the customer/casting info, producing a disk file called INFO/123. If we want to save the cost info to disk using option 2, we will be asked to type in a file name. We may want the name to be the same as a cost info file that we previously saved but whose name we forgot. In that case, pressing the "RETURN" key instead of typing in a file name will return us to the menu, where we can view a catalog of file names on the disk by choosing option 5.

Having saved our data to disk, let's take a coffee break: choose option 7 on the Quit/Store menu to leave the program and generate the sign-off message. If we have pressed the "7" key by accident, we can get back to the Main Menu with no loss of data by typing GOTO 10. However, resetting all of the data to design a new casting requires us to type RUN HELLO, or to turn the power switch OFF and then ON again.

```
THANK YOU AND GOOD DAY


TO RESUME WITH THE SAME CASTING, TYPE:
                              GOTO 10

TO RUN A NEW CASTING, TYPE:
                              RUN HELLO
```

We have had our coffee break, but there is still work to be done: this casting requires two risers, and we have only designed one of them. If our Apple is still turned on and has not been disturbed, we can quickly get back into the main program by typing GOTO 10.

We want to riser a new section, so we choose option 4 from the Main Menu, and get a warning message! (When we saved the section/riser data for riser # 1, we did not zero the section variables). Since we are designing a new riser section and our data is already saved, we press the "1" key to erase the old section data from memory and run the CASTING SHAPE/SIZE program.

```
      CASTING SHAPE/SIZE


DATA ALREADY EXISTS FOR THIS SECTION!

DO YOU WANT TO:

   1. ERASE THE DATA

   2. STORE THE DATA ON DISK

   3. CARRY ON REGARDLESS

   4. RETURN TO MAIN MENU

WHICH?  PRESS A NUMBER KEY...
```

For this new section, we go through the same set of steps: describing two sub-sections (only one has chills this time), choosing a sand riser with hot topping and height/diameter ratio of 1 and a riser neck of standard length. Then we return to the Main Menu, save the section/riser data for riser 2, and select Main Menu option 6: Gating System.

On the first screen of the Gating System option we must enter several gating system parameters, including height and depth information required to calculate pressures. Any gates attached to the casting must be cut off at fettling time, whereas gates attached to risers need not be cut - this data is used in the cost calculation. On the second screen (not shown), we are asked whether all section risers have been analysed and stored on disk. If so, the program reads the data from the disk files and adds up all the liquid metal in the casting, as well as other parameters needed for later cost estimation. All of this data needs to be on disk files - the program will not add to the section/riser design in memory.

Finally, the third screen of the Gating System option (shown) tells us the net weight of the casting and the derived gating system parameters. If necessary, we can substitute other values for the gating system parameters.

```
          GATING SYSTEM


GATE/SPRUE AREA RATIO:  2

SPRUE HEIGHT (IN):          3

PATTERN HT. IN COPE (IN):   3

PATTERN DEPTH IN DRAG (IN): 2.5

TOTAL NUMBER OF GATES:          2

# GATES ATTACHED TO CASTING:   2


CHANGE ANY OF THE ABOVE?  Y/N
```

```
          GATING SYSTEM


  WEIGHT OF CASTING  (LB):  52
  MODULUS OF CASTING (IN):  .41

POURING TIME (SECONDS):  9

FLUIDITY OF STEEL (IN):  25.8

SPRUE BASE DIAMETER (IN):   1.1

NET AREA OF GATES (SQ.IN):  1.7

WEIGHT OF GATING SYSTEM (LB):  9.2


CHANGE ANY OF THE ABOVE?  Y/N
```

The gating system analysis completes our design for this casting. We should re-enter QUIT/STORE FILES ON DISK to save the customer/casting info (which now contains gating system data in memor). Then we can go back to the Cost ANALYSIS option to generate a printout of the next costs for the casting as a whole. That printout is shown on the last page.

COST ANALYSIS FOR ENTIRE CASTING

BY: JOHN DOE
DATE: 28 MARCH, 1984

FOR: UNIVERSAL VALVES, LTD.
2500 PRINCESS ST.
KINGSTON, ONTARIO K7L 3N6

PURCHASE ORDER #: 123
CASTING DESCRIPTION: 6" INNER DIAM VALVE HOUSING

USING LOW ALLOY OR CARBON STEEL AT A POURING TEMPERATURE OF 2912 F

MOLDING MATERIAL: GREEN SILICA SAND

MOLTEN METAL.....	84	LB	$ 42.03	
RISER/GATE CUTOFF...	8.4	SQ.IN	$ 1.27	NUMBER OF RISERS: 2
CHILL REMOVAL.....	49.5	SQ.IN	$ 4.95	
HOT TOPPING.....	0.50	LB	$ 0.10	DENSITY: .071 LB/CU.IN
TOP INSULATION.....				
RISER SLEEVES.....				
SCRAP CREDIT.....	27	LB	$ -4.12	
NET COSTS.....			$ 44.23	

WEIGHT OF CASTING: 52 LB
WEIGHT OF RISERS/NECKS: 21 LB
WEIGHT OF GATING SYSTEM: 9 LB

NET YIELD: 62.9 %

GATING SYSTEM:

GATE/SPRUE AREA RATIO: 2
SPRUE HEIGHT: 3 IN
PATTERN HT IN COPE: 3 IN
PATTERN DEPTH IN DRAG: 2.5 IN
NUMBER OF GATES: 2
FLUIDITY OF STEEL: 25.8 IN
POURING TIME: 9.3 SECONDS

CANMET RISERING PROGRAMME
POSSIBLE FUTURE DEVELOPMENTS

1. EXTENDED SHAPE DESCRIPTION CAPABILITY

   - Additional three-dimensional shapes may be set as necessary, to extend the library of elementary section descriptions.
   - For complex shapes, user interfaces should be developed for other graphic input devices (HI Pad, 3-D Space Tablet, etc.).

2. FEEDING DISTANCE

   - Feeding distance of parasite sections (appendages) may be added to the analysis as experimental data is accumulated.
   - Vertical vs horizontal feeding distances should be evaluated and incorporated as necessary.

3. SIDE RISERS

   - Feeding distance and riser size/neck design need to be developed for side risers.

4. KNOCK-OFF CORES

   - Dimensions of knock-off cores for top risers should be calculated, and knock-off cores should be included as a riser neck option.

5. BOTTOM-RISERED SECTIONS

   - The design of top risers is affected by the presence of blind bottom risers feeding the same section. Allowance should be made for this effect.

6. GATING SYSTEM DESIGN

   - A more general gating design calculation should be set up, with both top gating and bottom gating designs available.

7. COMPUTER UPGRADE

   - Apple has introduced a new disk operating system, PRODOS, which will be included with all new Apple IIe computers. the programs should be altered to work with PRODOS.

   - The programme should be converted to run on the IBM Personal Computer, since it is rapidly gaining popularity with small businesses.

CANMET RISERING PROGRAMME

PROGRAMME VARIABLES

The CUSTOMER/CASTING INFO variables stored on disk at the user's option are:

CA$ - customer address (up to 100 characters)
CC$ - customer city/privince (up to 98 characters)
CD$ - casting description (up to 137 characters)
CN$ - Customer name (up to 103 characters)
DT$ - date of analysis (up to 64 characters)
MM$ - moulding material (pre-defined names)
PO$ - purchase order code (up to 60 characters, the first 20 of which are used as part of disk file names)
UO$ - units (<I>mperial or <M>etric)
UN$ - user name (up to 107 characters)

AG - area of connection between gates and casting
AN - net area of chills on casting
DF - density of steel
DI - density of top insulation, if any
DT - superheat of steel, in degrees Celsius
FF - feeding factor for moulding material
FL - fluidity of the steel (function of PT)
GA - net area of gates
GS - gate/sprue area ratio for gating system
HC - height of pattern in cope
HD - depth of pattern in drag
HS - height of sprue in gating system
IC - net cost of all top insulation
IW - total weight of top insulation on all risers
MM - total number of risers on the casting
MP - melting point of steel
MW - mould wall movement allowance for moulding material
NA - number of gates attached to casting
NC - net chill area summed over casting sections
NG - number of gates attached to casting and risers
NV - net neck volume summed over casting sections
PT - pouring temperature of steel
RV - net riser volume summed over casting sections
SH - per cent shrinkage of steel (function of PC and PT)
SL - net length of sleeves for all risers
SN - net surface area summed over casting sections
SP - net price of sleeves summed over riser
SS - total number of sleeves used for the casting
TD - density of hot topping used on the riser
TP - pouring time for metal into gating system
VG - volume of gating system
VN - net volume summed over casting sections
WT - total weight of hot topping on all risers

The COST ANALYSIS variables stored on disk at the user's option are:

CM - cost of metal per unit weight
CR - credit for scrap metal per unit weight
CT - cost of hot topping per unit weight
CI - cost of top insulation per unit weight
CC - cost of riser and gate cutoff loss per unit area
CH - cost of removing chills per unit area
CP - cost of removing padding per unit volume

The SECTION/RISER DATA variables stored on disk at the user's option are:

AC - area of chills on casting section
AC()- area of chills on sub-section
AJ()- area of junction between any two sub-sections
CI - cost of top insulation
CN - number of chills on the casting section
CN()- number of chills on sub-section
CS - net cost of insulating sleeve (if any)
LS - net length of insulating sleeve (may be cut to size)
ND - neck diameter for knock-off core
NL - neck length for knock-off core
NR - number of identical sections with the same riser design
RD - riser diameter for the casting section
RH - riser height for the casting section
RT - riser type parameter (values 1 through 7)
SA - apparent surface alteration factor for sleeve (if any)
SC - effective surface area of casting section
SC()- effective surface area of sub-section
SR - sub-section number on which riser is placed
TI - thickness of top insulation (if any)
TW - weight of hot topping for the riser
VC - volume of casting section
VC()- volume of sub-section (10 values per risered section)
VR - riser volume for the casting section

Additional casting variables not stored on disk:

MC - modulus of sub-section on which riser is placed
MR - effective modulus of a section riser
MN - number of sub-sections fed by a given riser
RF - riser factor (for use in RISER SIZE/NECK) option
RN - current riser number (for multiple-riser castings)
SD - sprue base diameter for the gating system
SS()- array used in RISER SIZE/NECK
SW - effective shrinkage factor for mold wall movement
WI - weight of top insulation for a given riser
XM - critical thickness for mold wall movement
YD - per cent yield of a given riser/casting section

Most variables with a single character name are re-definable - i.e. they may be used to represent different things in different parts of the program. Variables with a single character name which are not re-defined are:

D$ - "RETURN"+"CTRL-D" character, for DOS commands in program
M$()- choice of riser types for RISER SIZE/NECK option
N - current sub-section number
N% - "number" flag for input character filter in programs
P - flag to determine whether header has been printed out
P$()- array of printer control codes
S$ - single space character, used for screen print formatting
X$ - contains 10 spaces, used for formatting numbers

```
                          +-------------------------+
 10                       ! ********************** !
 10                       ! * CANMET RISERING 2.1 * !
 10                       ! *                    * !
 10                       ! *   "HELLO" PROGRAM  * !
 10                       ! ********************** !
                          +-------------------------+
100 TEXT :
    HOME :
    PRINT CHR$(12):
    VTAB 5:
    PRINT "PLEASE SWITCH TO 40-COLUMN DISPLAY":
    HOME :
    PRINT CHR$(4)"NOMONCIO":
    NOTRACE :                          !  ALLOW FOR ENTRY FROM UNUSUAL CONFIGU
                                         RATIONS
120 IF PEEK(104) > 8 THEN
       POKE 103,1:
       POKE 104,8:
       POKE 2048,0:
       PRINT CHR$(4)"RUN HELLO":       ! ENSURE START AT BOTTOM OF MEMORY
130 PRINT CHR$(4)"BLOAD CANMET SUPPORT":
    PRINT CHR$(4)"BRUN RAMDISK":
    D$ = CHR$(4):
    S$ = " ":
    RN = 10:
    N = 1
                              +----------------+
200                           ! DEFAULT VALUES !
                              +----------------+
290 DD = 1:                           ! DRIVE FOR DATA DISK
295 :

300 P% = 1:                           ! PRINTER INTERFACE SLOT NUMBER
302 P$(0) = CHR$(12):                 ! FORM-FEED FOR EPSON PRINTER
304 P$(1) = CHR$(15):                 ! TURN CONDENSED PRINTING ON
306 P$(2) = CHR$(18):                 ! TURN CONDENSED PRINTING OFF
308 P$(3) = CHR$(14):                 ! TURN ENLARGED PRINTING ON
310 P$(4) = CHR$(20):                 ! TURN ENLARGED PRINTING OFF
314 :
    :                                 ! THE FOLLOWING MUST BE PRECEDED
                                          BY CHR$(27) FOR EPSON
316 P$(5) = CHR$(69):                 ! TURN EMPHASIZED PRINTING ON
318 P$(6) = CHR$(70):                 ! TURN EMPHASIZED PRINTING OFF
320 P$(7) = CHR$(71):                 ! TURN DOUBLE PRINT ON
322 P$(8) = CHR$(72):                 ! TURN DOUBLE PRINT OFF
400 :

500 MM$ = " GREEN SILICA SAND ":      ! MOLDING MATERIAL
700 FF = 1:                           ! FEEDING FACTOR FOR MM$
800 MW = 2:                           ! MOLD WALL MOVEMENT (%) FOR MM$
850 XM = .75:                         ! CRITICAL MWM DEPTH (IN)
```

```
 900 :

 950 MP = 2760:                          ! MELTING POINTOF METAL (F)
1000 PT = 2912:                          ! POURING TEMPERATURE (F)
1050 SH = 4.0:                           ! % SHRINKAGE FOR METAL
1100 DF = .283:                          ! DENSITY OF STEEL (LB/CU.IN)
1200 TD = .071:                          ! DENSITY OF HOT TOPPING (LB/CU.IN)
1300 DI = .001:                          ! DENSITY OF TOP INSULATION (LB/CU.IN)
1400 :

1500 GS = 2:                             ! GATE/SPRUE AREA RATIO
1700 :

1800 U0$ = "I":                          ! IMPERIAL UNITS:
1900 :

2000 U1$ = "IN":                         ! LENGTH
2100 U2$ = "LB":                         ! WEIGHT
2200 U3$ = "SQ.IN":                      ! AREA
2300 U4$ = "CU.IN":                      ! VOLUME
2400 U5$ = "F":                          ! TEMPERATURE
2500 U6$ = "LB/CU.IN":                   ! DENSITY
2600 :

2700 IF U0$ = "M" THEN
        U1$ = "CM":
        U2$ = "KG":
        U3$ = "SQ.CM":
        U4$ = "CU.CM":
        U5$ = "C":
        U6$ = "GM/CU.CM"
                                 +------------------+
3670                             ! SUPPORT PROGRAMS !
                                 +------------------+
3672 PRINT D$"BLOAD RECTANGULAR SHAPES":
     PRINT D$"BSAVE RECTANGULAR SHAPES,V222,A16384,L2134":
     PRINT D$"BLOAD ANNULAR SHAPES":
     PRINT D$"BSAVE ANNULAR SHAPES,V222,A16384,L2685"
3674 PRINT D$"BLOAD HGR TEXT WRITER,A16384":
     PRINT D$"BSAVE HGR TEXT WRITER,V222,A16384,L2304":
     POKE 809,P%:
     POKE 232,0:
     POKE 233,8:
     POKE  - 16301,0:
     HCOLOR= 3
                               +---------------------+
3810                           ! RISER TYPE OPTIONS !
                               +---------------------+
3820 M$(1) = " SLEEVE WITH HOT TOPPING ":
     M$(2) = " SLEEVE WITH INSULATED TOP ":
     M$(3) = " SLEEVED BLIND RISER ":
     M$(4) = " SLEEVE WITH OPEN TOP "
```

```
3830 M$(5) = " SAND RISER WITH HOT TOPPING ":
     M$(6) = " BLIND SAND RISER ":
     M$(7) = " SAND RISER WITH OPEN TOP ":
     M$(8) = "CAUTION: TOP OF RISER WILL FREEZE EARLY,     POSSIBLY CAUSING FEE
     DING PROBLEMS."
                              +--------------------------+
3840                          ! CHECK ON FREE DISK SPACE !
                              +--------------------------+
3850 FOR I = 730 TO 759:
        READ L:
        POKE I,L:
     NEXT :
     DATA  169,0,133,6,133,7,160,200,24,185,242,179,240,12,10,144,251,230,6,208
     ,2,230,7,24,144,242,136,208,235,96
3860 POKE 34,8:
     VTAB 24:
     HTAB 5:
     INVERSE :
     PRINT "PRESS SPACE BAR TO START...";:
     NORMAL :
     PRINT " ";:
     GOSUB 5000:
     GOSUB 5200:
     CALL 730:
     L = PEEK(6) + PEEK(7) * 256
3866 ON L > 14 GOTO 3870:
     CALL 778:
     VTAB 10:
     HTAB 3:
     FLASH :
     PRINT "WARNING:";:
     NORMAL :
     PRINT " THERE ARE FEWER THAN 15":
     PRINT :
     PRINT "     FREE SECTORS ON THIS DISK!"
3868 VTAB 16:
     PRINT "  INSERT A FRESH MASTER PROGRAM DISK":
     PRINT :
     PRINT "  IF YOU WILL BE CREATING NEW FILES.":
     VTAB 24:
     HTAB 5:
     INVERSE :
     PRINT " PRESS SPACE BAR TO START...";:
     NORMAL :
     PRINT " ";:
     GOSUB 5000:
     HOME
                                 +--------------------+
3869                             ! CHOICE OF PROGRAMS !
                                 +--------------------+
3870 POKE 34,0:
     VTAB 10:
```

```
      PRINT "   1. RUN THE RISER PROGRAM":
      VTAB 13:
      PRINT "   2. CREATE/EDIT RISER SLEEVE FILE"
3880  VTAB 16:
      PRINT "   3. LOOK AT INSTRUCTIONS":
      VTAB 19:
      PRINT "   4. QUIT":
      VTAB 23:
      PRINT "   WHICH?  PRESS A NUMBER KEY... ";
3895  GOSUB 5000:
      L = VAL(R$):
      IF L < 1 OR L > 4 THEN
         CALL 778:
         GOTO 3895
3900  GOSUB 5200:
      IF L = 4 THEN
         END
                              +----------------------------+
4000                          ! CHAIN TO SELECTED PROGRAM !
                              +----------------------------+
4100  VTAB 10:
      HTAB 9:
      INVERSE :
      PRINT " PLEASE WAIT WHILE ":
      HTAB 9:
      PRINT " PROGRAM IS LOADED ":
      NORMAL
4200  PRINT D$"OPEN SCRATCH1,V222":
      PRINT D$"DELETE SCRATCH1,V222":
      PRINT D$"OPEN SCRATCH1,V222":
      PRINT D$"WRITE SCRATCH1"
4300  R$ = CHR$(13):
      PRINT S$R$S$R$S$R$S$R$S$R$S$R$S$R$MM$R$ASC(P$(0))R$;:
      FOR I = 1 TO 8:
         PRINT M$(I)R$ASC(P$(I))R$;:
      NEXT :
      PRINT "0,0,"DD","DI","FF","MP","MW",0,0,"Px","PT",0,0,0,0,"SH","TD",0,0,0,
      "XH
4400  PRINT D$"OPEN SCRATCH2,V222":
      PRINT D$"DELETE SCRATCH2,V222":
      PRINT D$"OPEN SCRATCH2,V222":
      PRINT D$"WRITE SCRATCH2":
      PRINT U0$","U1$","U2$","U3$","U4$","U5$","U6$",";:
      PRINT "0,0,0,"DF",0,0,0,0,0,"N",0,0,0,0,"RN",0,0,0,0,0,0,0,0,0,0,0"
4500  FOR I = 0 TO 9:
         PRINT "0,0,0,0":
      NEXT
4600  FOR I = 0 TO 9:
         FOR J = 0 TO 9:
            PRINT "0":
         NEXT :
      NEXT :
```

```
      PRINT D$"OPEN SCRATCH3,V222":
      PRINT D$"DELETE SCRATCH3,V222":
      PRINT D$"OPEN SCRATCH3,V222":
      PRINT D$"WRITE SCRATCH3":
      PRINT "0,0,0,0,0,0,0,0,0,0,"GS",0,0,0,0,0,0,0,0,0"
 4610 PRINT D$"CLOSE"
 4620 ON L GOTO 4700,4800,4900
 4700 PRINT D$"RUN CANMET MAIN PROGRAM"
 4800 PRINT D$"RUN CREATE/EDIT SLEEVES"
 4900 PRINT D$"RUN INSTRUCTIONS"
                                        +-------+
 4950                                   ! SUBS !
                                        +-------+
 5000 GET R$:
      IF R$ = CHR$(16) THEN
         CALL 800:
         GOTO 5000
 5100 RETURN
 5200 FOR I = 1 TO 20:
         POKE 32,39 - I:
         POKE 33,I + 1:
         HOME :
         POKE 32,0:
         POKE 33,I:
         HOME :
      NEXT :
      POKE 33,40:
      RETURN
                          +----------------------------+
63998                     !                            !
63998                     ! 3 APR 1984                 !
63998                     !                            !
64000                     ! M.R. VINER                 !
64000                     ! METALLURGICAL ENGINEERING  !
64000                     ! QUEEN'S UNIVERSITY         !
64000                     ! KINGSTON, ONTARIO  K7L 3N6 !
                          +----------------------------+
```

****

VARIABLE CROSS REFERENCE:

D$	130	3672	3674	4200	4400	4600	4610	4700	4800	4900
DD	290	4300								
DF	1100	4400								
DI	1300	4300								
FF	700	4300								
GS	1500	4600								
I	3850	4300	4500	4600	5200					
*J	4600									
L	3850	3860	3866	3895	3900	4620				
M$(	3820	3830	4300							
MM$	500	4300								
MP	950	4300								
MW	800	4300								
N	130	4400								
P$(	302	304	306	308	310	316	318	320	322	4300
P%	300	3674	4300							
PT	1000	4300								
R$	3895	4300	5000							
RN	130	4400								
S$	130	4300								
SH	1050	4300								
TD	1200	4300								
U0$	1800	2700	4400							
U1$	2000	2700	4400							
U2$	2100	2700	4400							
U3$	2200	2700	4400							
U4$	2300	2700	4400							
U5$	2400	2700	4400							
U6$	2500	2700	4400							
XM	850	4300								

NOTES:

* INDICATES SYMBOL REFERENCED AT ONE LINE NUMBER ONLY.
** INDICATES SYMBOL EQUIVALENT TO PREVIOUSLY DEFINED SYMBOL.
-> INDICATES UNDEFINED SYMBOL.

LINE NUMBER 99999 ==> TOO MANY REFERENCES TO THE VARIABLE;
LATER REFERENCES ARE NOT LISTED.

```
                          +---------------------------+
                          ! ************************* !
 10                       ! *  CANMET RISERING 2.1  * !
 10                       ! *                       * !
 10                       ! *  CREATE/EDIT SLEEVES  * !
 10                       ! ************************* !
 10                       +---------------------------+

100 POKE 51,128:
    ON D$ <  > "" GOTO 10000:
    U$ = "I":
    U1$ = "IN":
    AU$ = "  METRIC  ":
    D$ = CHR$(13) + CHR$(4):
    S$ = " ":
    X$ = "          "
200 IF PEEK(780) + PEEK(781) <  > 140 THEN
       PRINT D$"BLOAD CANMET SUPPORT":
       VTAB 23:
       HTAB 1:
       INVERSE :
       PRINT "PRESS SPACE BAR TO CONTINUE";:
       NORMAL :
       PRINT " ";:
       GET R$
250 GOTO 10000
                            +-------------------------+
300                         !  *** SUBROUTINES ***  !
                            +-------------------------+

400 GET R$:
    IF R$ = CHR$(16) THEN
       CALL 800:
       GOTO 400
500 RETURN
                           +---------------------------+
600                        !  CHARACTER/NUMBER INPUT   !
                           +---------------------------+

700 L% = 1:
    Q$ = ""
800 GET R$:
    L = ASC(R$):
    IF L = 13 THEN
       R = VAL(S$ + Q$) + R * (L% = 1):
       RETURN
1000 ON L = 8 GOTO 1300:
    IF L < 32 THEN
       CALL 778:
       GOTO 800
1100 IF N% AND (L < 46 OR L = 47 OR L > 57) THEN
       CALL 778:
       GOTO 800
1200 PRINT R$;:
    L% = L% + 1:
```

```
     Q$ = Q$ + R$:
     GOTO 800
1300 L% = L% - 1:
     IF L% < 1 GOTO 700
1400 PRINT R$" "R$;:
     IF L% = 1 GOTO 700
1500 Q$ = LEFT$(Q$,L% - 1):
     GOTO 800
                                        +---+
1600                                    !   !
                                        +---+

1700 VTAB 24:
     HTAB 1:
     PRINT "    SET ";:
     INVERSE :
     PRINT "DIAMETER = 0 ";:
     NORMAL :
     PRINT " TO QUIT";:
     HTAB 1:
     RETURN
                                        +---+
1800                                    !   !
                                        +---+

1900 VTAB 23:
     HTAB 1:
     PRINT "CHANGE ANY OF THE ABOVE? ";:
     CALL  - 958
2000 INVERSE :
     PRINT "Y/N";:
     NORMAL :
     PRINT " ";:
     GOSUB 400:
     IF R$ = "y" THEN
        R$ = "Y"
2100 HTAB 1:
     RETURN
                                        +---+
2200                                    !   !
                                        +---+

2300 VTAB 23:
     HTAB 1:
     PRINT "PRESS ";:
     INVERSE :
     PRINT "RETURN";:
     NORMAL :
     PRINT " TO LEAVE ENTRY UNCHANGED":
     RETURN
2400 PRINT "  SET ";:
     INVERSE :
     PRINT "DIAM=0";:
     NORMAL :
     PRINT " TO DELETE RECORD FROM FILE";:
```

```
     HTAB 1:
     RETURN
                                          +---+
2500                                      !   !
                                          +---+
2600 HOME :
     VTAB 6:
     PRINT "DIAMETER OF THE SLEEVE ("U1$"):":
     VTAB 9:
     PRINT "LENGTH OF THE SLEEVE   ("U1$"):"
2700 VTAB 12:
     PRINT "APPARENT SURFACE ALTERATION":
     PRINT "       FACTOR OF THE SLEEVE:":
     VTAB 16:
     PRINT "NET COST OF THE SLEEVE ($):":
     VTAB 19:
     PRINT "WILL IT BE CUT TO SIZE?  ";:
     INVERSE :
     PRINT "Y/N":
     NORMAL :
     RETURN
                                          +---+
2800                                      !   !
                                          +---+
2900 PRINT "WHICH?  PRESS A NUMBER KEY...  ";
3000 GOSUB 400:
     R% = VAL(R$):
     IF R% < 1 OR R% > L% THEN
        CALL 778:
        GOTO 3000
3100 PRINT R$:
     PRINT :
     RETURN
                                          +---+
3200                                      !   !
                                          +---+
3300 VTAB 24:
     HTAB 1:
     CALL  - 958:
     HTAB 8:
     INVERSE :
     PRINT "C";:
     NORMAL :
     PRINT "ONTINUE    ";:
     INVERSE :
     PRINT "P";:
     NORMAL :
     PRINT "RINT    ";:
     INVERSE :
     PRINT "M";:
     NORMAL :
     PRINT "ENU";
```

```
3400 GOSUB 400:
     VTAB 1:
     PRINT
3500 IF R$ = "p" OR R$ = "P" THEN
        CALL 800:
        GOTO 3300
3600 IF R$ = "m" OR R$ = "M" THEN
        I = ZL + 1:
        RETURN
3700 IF R$ = "c" OR R$ = "C" THEN
        HOME :
        RETURN
3800 CALL 778:
     GOTO 3400
                                          +--+
3840                                      !  !
                                          +--+
3850 VTAB 24:
     HTAB 1:
     CALL  - 958:
     HTAB 5:
     PRINT "PRESS ";:
     INVERSE :
     PRINT "SPACE BAR";:
     NORMAL :
     PRINT " TO CONTINUE...";:
     HTAB 1:
     RETURN
                                +--------------------+
3900                            !  FORMATTED PRINT   !
                                +--------------------+
4000 PRINT RIGHT$(X$ + STR$(INT(R)),L%);:
     RETURN
4100 R$ = STR$(INT(R * 10^ D% + .5)):
     SIGN$ = "":
     IF LEFT$(A$,1) = "-" THEN
        R$ = RIGHT$(R$,LEN(R$) - 1):
        SIGN$ = "-"
4200 R% = LEN(R$):
     IF R% < D% + 1 THEN
        R$ = "0" + R$:
        GOTO 4200
4300 PRINT RIGHT$(X$ + SIGN$ + LEFT$(R$,R% - D%) + "." + RIGHT$(R$,D%),L%);:
     RETURN
                       +-----------------------------------+
4400                   !  CHECK ON PRE-DEFINED FILE NAME   !
                       +-----------------------------------+
4500 ONERR GOTO 6100
4600 IF F$ = "" THEN
        GOSUB 4900:
        VTAB 18:
        PRINT D$"VERIFY "F$:
```

```
        ONERR GOTO 5600
 4650 PRINT D$"OPEN "F$",L25":
      PRINT D$"READ "F$",R0":
      INPUT A$:
      ZL = VAL(A$):
      PRINT D$"CLOSE"
 4700 ONERR GOTO 5200
 4750 RETURN
                                          +--+
 4800                                     !  !
                                          +--+

 4900 INVERSE :
      PRINT "NAME OF DISK FILE: ";:
      NORMAL :
      CALL  - 958:
      PRINT " ";:
      N% = 0:
      GOSUB 700:
      IF Q$ = "" THEN
         POP :
         GOTO 10000
 5000 F$ = Q$:
      RETURN
                              +-------------------------+
 5100                         !  ERROR HANDLER & EXIT   !
                              +-------------------------+

 5200 PRINT D$"CLOSE":
      R = PEEK(222):
      CALL 778:
      IF R = 8 THEN
         INVERSE :
         PRINT "I/O ERROR.";:
         NORMAL :
         PRINT " CHECK DISK DRIVE..."X$:
         GOSUB 3850:
         GOTO 10000
 5300 IF R = 9 THEN
         INVERSE :
         PRINT "DISK FULL.";:
         CALL  - 958:
         NORMAL :
         PRINT :
         PRINT "DELETE SOME FILES OR CHANGE DISKS...":
         GOSUB 3850:
         DIAM = 0:
         ZL = ZL - 1:
         GOTO 15400
 5400 IF R = 10 THEN
         INVERSE :
         PRINT "FILE LOCKED.";:
         NORMAL :
         PRINT " TRY ANOTHER NAME..."X$:
```

```
        GOSUB 3850:
        GOTO 10000
5500 IF R = 11 THEN
        INVERSE :
        PRINT "BAD FILE NAME.";:
        NORMAL :
        PRINT " TRY AGAIN..."X$:
        GOSUB 3850:
        GOTO 10000
5600 HOME :
     VTAB 6:
     PRINT "EXIT ON ERROR NUMBER ";PEEK(222):
     VTAB 8:
     PRINT "AT LINE NUMBER ";PEEK(218) + 256 * PEEK(219):
     GOTO 5800
5700 HOME :
     VTAB 7:
     PRINT "THANK YOU AND GOOD DAY"
5800 VTAB 11:
     PRINT :
     PRINT "TO RESTART THIS PROGRAM, TYPE:":
     HTAB 27:
     INVERSE :
     PRINT " GOTO 10 ":
     NORMAL :
     PRINT :
     PRINT "TO RUN THE RISER PROGRAM, TYPE:"
5900 HTAB 27:
     INVERSE :
     PRINT " RUN HELLO ":
     NORMAL :
     PRINT :
     PRINT :
     POKE 34,0:
     END
                                        +---+
6000                                    !   !
                                        +---+
6100 ON PEEK(222) = 6 GOTO 6300:
     ONERR GOTO 5200
6200 POP :
     GOTO 5200
6300 HTAB 1:
     CALL  - 958:
     CALL 778:
     PRINT "FILE NOT FOUND.  TRY AGAIN":
     CALL 778:
     F$ = "":
     GOTO 4500
                          +--------------------------+
9999                      !  **** MAIN PROGRAM ****  !
                          +--------------------------+
```

```
10000 POKE 34,0:
      HOME :
      INVERSE :
      HTAB 4:
      PRINT "  RISER SLEEVE FILES: MENU    ":
      HTAB 4:
      PRINT SPC( 30)"":
      NORMAL :
      VTAB 5:
      I = FRE(0):
      POKE 34,2
10100 PRINT "  1. SWITCH TO ";:
      INVERSE :
      PRINT AU$;:
      NORMAL :
      PRINT " UNITS":
      PRINT :
      PRINT "  2. CREATE A NEW RISER SLEEVE FILE":
      PRINT :
      PRINT "  3. SCAN ALL ENTRIES IN THE FILE"
10200 PRINT :
      PRINT "  4. CHANGE OR DELETE AN ENTRY":
      PRINT :
      PRINT "  5. ADD TO THE END OF THE FILE":
      PRINT :
      PRINT "  6. RUN THE RISERING PROGRAM"
10300 PRINT :
      PRINT "  7. QUIT":
      PRINT :
      PRINT :
      L% = 7:
      ONERR GOTO 5200
10400 GOSUB 2900:
      ON R% GOTO 10600,11000,11500,12500,14800,16500,5700
                              +-------------------------+
10500                         !  *** SWITCH UNITS ***   !
                              +-------------------------+

10600 IF U$ = "I" THEN
         U$ = "M":
         U1$ = "CM":
         AU$ = " IMPERIAL ":
         GOTO 10800
10700 U$ = "I":
      U1$ = "IN":
      AU$ = "  METRIC  "
10800 VTAB 5:
      HTAB 16:
      INVERSE :
      PRINT AU$:
      NORMAL :
      VTAB 20:
      CALL  - 958:
```

```
      GOTO 10400
                              +----------------------------+
10900                         !  *** CREATE NEW FILE ***  !
                              +----------------------------+
11000 VTAB 1:
      HTAB 26:
      INVERSE :
      PRINT "CREATE":
      NORMAL :
      VTAB 3:
      CALL  - 958:
      VTAB 8:
      GOSUB 4900:
      ONERR GOTO 11300
11100 PRINT D$"VERIFY "F$:
      PRINT :
      PRINT "   THAT FILE ALREADY EXISTS.":
      PRINT :
      PRINT "   ERASE AND RE-USE IT? ";:
      GOSUB 2000:
      ON R$ <  > "Y" GOTO 10000:
      ONERR GOTO 5200
11200 PRINT D$"DELETE "F$
11300 ONERR GOTO 5200
11350 POKE 216,0:
      PRINT D$"OPEN "F$",L25":
      PRINT D$"WRITE "F$",R0":
      PRINT X$X$X$:
      PRINT CHR$(4)"WRITE "F$",R1":
      PRINT X$X$X$:
      PRINT CHR$(4):
      ZL = 0:
      VTAB 3:
      PRINT "   FILE NAME: "F$:
      POKE 34,3:
      GOTO 15000
                            +------------------------------+
11400                       !  *** SCAN FILE ENTRIES ***  !
                            +------------------------------+
11500 GOSUB 4500:
      VTAB 1:
      HTAB 26:
      INVERSE :
      PRINT "SCAN  ":
      NORMAL :
      PRINT :
      PRINT "   FILE NAME: "F$:
      CALL  - 958:
      PRINT D$"OPEN "F$",L25"
11550 VTAB 5:
      HTAB 35:
      PRINT "TO BE":
```

```
      PRINT " DIAMETER   LENGTH   ASAF  COST   CUT?":
      PRINT " --------  --------  ----  -----  -----"
11600 POKE 34,7:
      HOME :
      FOR I = 1 TO ZL:
         PRINT CHR$(4)"READ "F$",R"I:
         INPUT A$:
         IF VAL(MID$(A$,2,6)) = 0 THEN 12000
11700    DIAM = VAL(MID$(A$,2,6)):
         LNGTH = VAL(MID$(A$,8,6)):
         ASAF = VAL(MID$(A$,14,4)):
         CST = VAL(MID$(A$,18,7)):
         Z$ = LEFT$(A$,1):
         CUT$ = "N":
         IF CST < 0 THEN
            CUT$ = "Y":
            CST =  - CST
11800    L$ = " IN":
         IF Z$ = "M" THEN
            L$ = " CM"
11900    D% = 2:
         L% = 6:
         R = DIAM:
         GOSUB 4100:
         PRINT L$;:
         D% = 1:
         L% = 7:
         R = LNGTH:
         GOSUB 4100:
         PRINT L$;:
         D% = 2:
         L% = 6:
         R = ASAF:
         GOSUB 4100:
         L% = 7:
         R = CST:
         GOSUB 4100:
         PRINT "    "CUT$:
         PRINT :
         IF PEEK(37) > 20 THEN
            PRINT D$:
            GOSUB 3300
12000 NEXT :
      PRINT D$"CLOSE":
      IF I - 1 > ZL THEN 12300
12100 PRINT "   NO MORE DATA IN SLEEVE FILE.":
      PRINT :
      PRINT " PRESS ";:
      INVERSE :
      PRINT " P ";:
      NORMAL :
      PRINT " TO PRINT, ";:
```

```
      INVERSE :
      PRINT " M ";:
      NORMAL :
      PRINT " FOR MENU"
12200 GET R$:
      IF R$ = "P" OR R$ = "p" THEN
         CALL 800:
         GOTO 12200
12300 GOTO 10000
                          +------------------------------+
12400                     !  *** EDIT FILE ENTRIES ***  !
                          +------------------------------+
12500 GOSUB 4500:
      VTAB 1:
      HTAB 26:
      INVERSE :
      PRINT "EDIT  ":
      NORMAL :
      PRINT :
      PRINT "   FILE NAME: "F$:
      I = FRE(0):
      POKE 34,3
12600 HOME :
      VTAB 10:
      PRINT "  VALUE OF DIAMETER: ";:
      N% = 1:
      R = 0:
      GOSUB 700:
      IF R = 0 THEN 10000
12700 I = 0:
      PRINT D$"OPEN "F$",L25":
      FOR L = 1 TO ZL:
         PRINT D$"READ "F$",R"L:
         INPUT A$:
         DIAM = VAL(MID$(A$,2,6)):
         IF DIAM = R THEN
            I = L:
            L = ZL
12800 NEXT :
      IF I THEN 13100
12900 PRINT D$"CLOSE":
      VTAB 14:
      PRINT "  DIAMETER NOT FOUND!  TRY AGAIN? ";:
      GOSUB 2000:
      ON R$ = "Y" GOTO 12600:
      GOTO 10000
13100 LNGTH = VAL(MID$(A$,8,6)):
      ASAF = VAL(MID$(A$,14,4)):
      CST = VAL(MID$(A$,18,7)):
      Z$ = LEFT$(A$,1)
13200 PRINT CHR$(4):
      GOSUB 2600:
```

```
      CUT$ = "N":
      L$ = "IN":
      IF Z$ = "M" THEN
         L$ = "CM"
13300 VTAB 6:
      HTAB 25:
      PRINT L$:
      VTAB 9:
      HTAB 25:
      PRINT L$:
      IF CST < 0 THEN
         CST =  - CST:
         CUT$ = "Y"
13400 VTAB 6:
      HTAB 30:
      PRINT DIAM:
      VTAB 9:
      HTAB 30:
      PRINT LNGTH:
      VTAB 13:
      HTAB 30:
      PRINT ASAF:
      VTAB 16:
      HTAB 30:
      PRINT CST:
      VTAB 19:
      HTAB 30:
      PRINT CUT$:
      GOSUB 2300:
      GOSUB 2400
13500 N% = 1:
      VTAB 6:
      HTAB 30:
      R = DIAM:
      GOSUB 700:
      IF DIAM <  > R THEN
         DIAM = R:
         PRINT X$
13600 IF DIAM = 0 THEN
         PRINT D$"WRITE "F$",R"I:
         PRINT X$X$X$:
         PRINT CHR$(4):
         HOME :
         GOTO 14500
13700 VTAB 9:
      HTAB 30:
      R = LNGTH:
      GOSUB 700:
      IF LNGTH <  > R THEN
         LNGTH = R:
         PRINT X$
13800 VTAB 13:
```

```
      HTAB 30:
      R = ASAF:
      GOSUB 700:
      IF ASAF < > R THEN
         ASAF = R:
         PRINT X$
13900 VTAB 16:
      HTAB 30:
      R = CST:
      GOSUB 700:
      IF CST < > R THEN
         CST = R:
         PRINT X$
14000 VTAB 19:
      HTAB 26:
      GOSUB 2000:
      CUT$ = "Y":
      IF R$ < > "Y" THEN
         CUT$ = "N"
14100 VTAB 19:
      HTAB 30:
      PRINT CUT$
14200 GOSUB 1900:
      IF R$ = "Y" THEN
         GOSUB 2300:
         GOSUB 2400:
         GOTO 13500
14300 IF CUT$ = "Y" THEN
         CST =  - CST
14400 VTAB 20:
      PRINT :
      PRINT D$"WRITE "F$",R"I:
      PRINT Z$;:
      D% = 2:
      L% = 6:
      R = DIAM:
      GOSUB 4100:
      D% = 1:
      R = LNGTH:
      GOSUB 4100:
      D% = 2:
      L% = 4:
      R = ASAF:
      GOSUB 4100:
      L% = 7:
      R = CST:
      GOSUB 4100
14500 PRINT D$"CLOSE":
      HOME :
      VTAB 10:
      PRINT "     EDIT ANOTHER RECORD? ";:
      GOSUB 2000:
```

```
      ON R$ = "Y" GOTO 12600:
      GOTO 10000
                          +----------------------------------+
14700                     !  *** ENTER NEW SLEEVE DATA ***  !
                          +----------------------------------+
14800 GOSUB 4500:
      VTAB 1:
      HTAB 26:
      INVERSE :
      PRINT "APPEND":
      NORMAL :
      PRINT :
      PRINT "   FILE NAME: "F$:
      POKE 34,3:
      HOME :
      I = FRE(0)
14900 PRINT D$"OPEN "F$",L25"
15000 ONERR GOTO 5600
15100 GOSUB 2600:
      GOSUB 1700
15200 DIAM = 0:
      LNGTH = 0:
      ASAF = 0:
      CST = 0:
      CUT$ = ""
15300 N% = 1:
      VTAB 6:
      HTAB 30:
      R = DIAM:
      GOSUB 700:
      IF DIAM <  > R THEN
         DIAM = R:
         PRINT X$
15400 IF DIAM = 0 THEN
         PRINT D$"WRITE "F$",R0":
         PRINT LEFT$(STR$(ZL) + X$ + X$ + X$,24):
         PRINT CHR$(4)"CLOSE":
         GOTO 10000
15500 VTAB 9:
      HTAB 30:
      R = LNGTH:
      GOSUB 700:
      IF LNGTH <  > R THEN
         LNGTH = R:
         PRINT X$
15600 VTAB 13:
      HTAB 30:
      R = ASAF:
      GOSUB 700:
      IF ASAF <  > R THEN
         ASAF = R:
         PRINT X$
```

```
15700 VTAB 16:
      HTAB 30:
      R = CST:
      GOSUB 700:
      IF CST <  > R THEN
         CST = R:
         PRINT X$
15800 VTAB 19:
      HTAB 26:
      GOSUB 2000:
      CUT$ = "Y":
      IF R$ <  > "Y" THEN
         CUT$ = "N"
15900 VTAB 19:
      HTAB 30:
      PRINT CUT$
16000 GOSUB 1900:
      IF R$ = "Y" THEN
         GOSUB 2300:
         GOSUB 1700:
         GOTO 15300
16100 IF CUT$ = "Y" THEN
         CST =  - CST
16150 VTAB 23:
      HTAB 1:
      CALL  - 958:
      HTAB 15:
      INVERSE :
      PRINT "WRITING...":
      NORMAL
16200 ZL = ZL + 1:
      VTAB 20:
      PRINT :
      PRINT D$"WRITE "F$",R"ZL:
      PRINT U$;:
      D% = 2:
      L% = 6:
      R = DIAM:
      GOSUB 4100:
      D% = 1:
      R = LNGTH:
      GOSUB 4100:
      D% = 2:
      L% = 4:
      R = ASAF:
      GOSUB 4100:
      L% = 7:
      R = CST:
      GOSUB 4100:
      PRINT :
      PRINT CHR$(4)
16300 POKE 32,29:
```

```
      POKE 33,11:
      HOME :
      POKE 32,0:
      POKE 33,40:
      VTAB 22:
      CALL  - 958:
      GOSUB 1700:
      GOTO 15200
                          +---------------------------------+
16400                     !  *** RUN RISERING PROGRAM ***  !
                          +---------------------------------+
16500 ONERR GOTO 16600
16550 PRINT D$"VERIFY SCRATCH2,V222":
      POKE 216,0:
      PRINT D$"RUN CANMET MAIN PROGRAM"
16600 POKE 216,0:
      PRINT D$"RUN HELLO"
                            +-----------------------------+
63998                       !                             !
63998                       ! 1 MAR 1984                  !
63998                       !                             !
64000                       ! M.R. VINER                  !
64000                       ! METALLURGICAL ENGINEERING   !
64000                       ! QUEEN'S UNIVERSITY          !
64000                       ! KINGSTON, ONTARIO  K7L 3N6  !
                            +-----------------------------+
```

VARIABLE CROSS REFERENCE:

```
  A$      4100  4650 11600 11700 12700 13100
  ASAF   11700 11900 13100 13400 13800 14400 15200 15600 16200
  AU$      100 10100 10600 10700 10800
  CST    11700 11900 13100 13300 13400 13900 14300 14400 15200 15700 16100 16200
  CUT$   11700 11900 13200 13300 13400 14000 14100 14300 15200 15800 15900 16100
  D$       100   200  4600  4650  5200 11100 11200 11350 11500 11900 12000 12700
         12900 13600 14400 14500 14900 15400 16200 16550 16600
  D%      4100  4200  4300 11900 14400 16200
  DIAM    5300 11700 11900 12700 13400 13500 13600 14400 15200 15300 15400 16200
  F$      4600  4650  5000  6300 11100 11200 11350 11500 11600 12500 12700 13600
         14400 14800 14900 15400 16200
  I       3600 10000 11600 12000 12500 12700 12800 13600 14400 14800
  L        800  1000  1100 12700
  L$     11800 11900 13200 13300
  L%       700   800  1200  1300  1400  1500  3000  4000  4300 10300 11900 14400
         16200
  LNGTH  11700 11900 13100 13400 13700 14400 15200 15500 16200
  N%      1100  4900 12600 13500 15300
  Q$       700   800  1200  1500  4900  5000
  R        800  4000  4100  5200  5300  5400  5500 11900 12600 12700 13500 13700
         13800 13900 14400 15300 15500 15600 15700 16200
  R$       200   400   800  1200  1400  2000  3000  3100  3500  3600  3700  4100
         4200  4300 11100 12200 12900 14000 14200 14500 15800 16000
  R%      3000  4200  4300 10400
  S$       100   800
  SIGN$   4100  4300
  U$       100 10600 10700 16200
  U1$      100  2600 10600 10700
  X$       100  4000  4300  5200  5400  5500 11350 13500 13600 13700 13800 13900
         15300 15400 15500 15600 15700
  Z$     11700 11800 13100 13200 14400
  ZL      3600  4650  5300 11350 11600 12000 12700 15400 16200
```

NOTES:

```
 * INDICATES SYMBOL REFERENCED AT ONE LINE NUMBER ONLY.
** INDICATES SYMBOL EQUIVALENT TO PREVIOUSLY DEFINED SYMBOL.
-> INDICATES UNDEFINED SYMBOL.

LINE NUMBER 99999 ==> TOO MANY REFERENCES TO THE VARIABLE;
                      LATER REFERENCES ARE NOT LISTED.
```

```
                          +-------------------------+
  10                      ! ********************** !
  10                      ! * CANNET RISERING 2.1 * !
  10                      ! *                    * !
  10                      ! *    MAIN PROGRAM    * !
  10                      ! ********************** !
                          +-------------------------+
 100 ON PEEK(780) + PEEK(781) <  > 140 GOTO 150:
     ONERR GOTO 150
 110 PRINT CHR$(4)"VERIFY SCRATCH2,V222":
     POKE 216,0:
     GOTO 12610
 150 POKE 216,0:
     HOME :
     VTAB 10:
     PRINT "  THIS PROGRAM WILL NOT RUN CORRECTLY":
     PRINT :
     PRINT "UNLESS CALLED FROM THE 'HELLO' PROGRAM."
 160 VTAB 16:
     PRINT "      PLEASE TYPE ";:
     INVERSE :
     PRINT " RUN HELLO ":
     NORMAL
                          +-------------------------+
 200                      !   *** SUBROUTINES ***   !
                          +-------------------------+
 250 GET R$:
     IF R$ = CHR$(16) THEN
        CALL 800:
        GOTO 250
 260 RETURN
                                        +---+
 270                                    !   !
                                        +---+
 300 HTAB L%:
     PRINT Q$;SPC( I - L% - LEN(Q$) + 1)"":
     RETURN
                                        +---+
 400                                    !   !
                                        +---+
1000 L% = 1:
     Q$ = ""
1100 GET R$:
     L = ASC(R$):
     ON L = 13 GOTO 1600:
     ON L = 8 GOTO 1500:
     IF L < 32 OR (N% AND (L < 46 OR L = 47 OR L > 57)) THEN
        CALL 778:
        GOTO 1100
1410 PRINT R$;:
     L% = L% + 1:
     Q$ = Q$ + R$:
```

```
     GOTO 1100
1500 L% = L% - 1:
     ON L% < 1 GOTO 1000:
     PRINT R$" "R$;:
     ON L% = 1 GOTO 1000:
     Q$ = LEFT$(Q$,L% - 1):
     GOTO 1100
1600 IF N% THEN
        R = VAL(S$ + Q$) + R * (L% = 1):
        IF R = 0 AND L% = 1 THEN
           CALL 778:
           GOTO 1100
1650 RETURN
                                        +---+
2700                                    !   !
                                        +---+
2800 VTAB 24:
     HTAB 1:
     PRINT "CHANGE ANY OF THE ABOVE?  ";:
     CALL  - 958
2900 INVERSE :
     PRINT "Y/N";:
     NORMAL :
     PRINT " ";:
     GOSUB 250:
     IF R$ = "y" THEN
        R$ = "Y"
3000 HTAB 1:
     RETURN
                                        +---+
3100                                    !   !
                                        +---+
3150 VTAB 24:
     HTAB 1:
     PRINT "PRESS <RETURN> TO LEAVE ENTRY UNCHANGED";:
     HTAB 1:
     RETURN
                                        +---+
3160                                    !   !
                                        +---+
3200 PRINT "WHICH?  PRESS A NUMBER KEY...  ";
3300 GOSUB 250:
     R% = VAL(R$):
     IF R% < 1 OR R% > L% THEN
        CALL 778:
        GOTO 3300
3400 PRINT R$:
     RETURN
                                        +---+
3900                                    !   !
                                        +---+
4000 VTAB 24:
```

```
     HTAB 1:
     CALL  - 958:
     HTAB 5:
     INVERSE :
     PRINT " PRESS SPACE BAR TO CONTINUE...";:
     NORMAL :
     GOSUB 250:
     VTAB 1:
     PRINT :
     RETURN
                                          +--+
4100                                      !  !
                                          +--+
4200 PRINT RIGHT$(X$ + STR$(INT(R)),L%);:
     RETURN
4300 R$ = STR$(INT(R * 10^ D% + .5)):
     F$ = "":
     IF LEFT$(R$,1) = "-" THEN
        R$ = RIGHT$(R$,LEN(R$) - 1):
        F$ = "-"
4310 R% = LEN(R$):
     IF R% < D% + 1 THEN
        R$ = "0" + R$:
        GOTO 4310
4320 PRINT RIGHT$(X$ + F$ + LEFT$(R$,R% - D%) + "." + RIGHT$(R$,D%),L%);:
     RETURN
                          +------------------------------+
4850                      !                              !
4850                      !     CONVERSION OF UNITS:     !
4850                      ! L=+1 --> METRIC TO IMPERIAL  !
4850                      ! L=-1 --> IMPERIAL TO METRIC  !
                          +------------------------------+
4880 :

                           +--------------------------+
4900                       !  TEMPERATURE CONVERSION  !
                           +--------------------------+
5000 PRINT "WORKING...";:
     L = 1 - 2 * (UO$ = "I"):
     PT = (PT - 32 * (L =  - 1)) * 1.8^ L + 32 * (L = 1):
     MP = (MP - 32 * (L =  - 1)) * 1.8^ L + 32 * (L = 1)
                             +---------------------+
5200                         !  VOLUME CONVERSION  !
                             +---------------------+
5300 Z = .061^ L:
     CP = CP / Z:
     MV = Z * MV:
     RV = Z * RV:
     VC = Z * VC:
     VG = Z * VG:
     VM = Z * VM:
     VR = Z * VR:
```

```
      FOR I = 0 TO 9:
         VC(I) = Z * VC(I):
      NEXT
                                  +--------------------+
5400                              ! AREA CONVERSION    !
                                  +--------------------+
5500  Z = .155^ L:
      AC = Z * AC:
      AG = Z * AG:
      AN = Z * AN:
      CC = CC / Z:
      CH = CH / Z:
      CI = CI / Z:
      GA = Z * GA:
      NC = Z * NC:
      NS = Z * NS:
      SC = Z * SC:
      SN = Z * SN
5550  FOR I = 0 TO 9:
         AC(I) = Z * AC(I):
         SC(I) = Z * SC(I):
         FOR J = 0 TO 9:
            AJ(I,J) = Z * AJ(I,J):
         NEXT :
      NEXT
                                  +----------------------+
5600                              ! WEIGHT CONVERSION    !
                                  +----------------------+
5700  Z = 2.2^ L:
      CM = CM / Z:
      CR = CR / Z:
      CT = CT / Z:
      IW = Z * IW:
      TW = Z * TW:
      WG = Z * WG:
      WT = Z * WT
                                  +----------------------+
5800                              ! LENGTH CONVERSION    !
                                  +----------------------+
5900  Z = .3937^ L:
      FL = Z * FL:
      HC = Z * HC:
      HD = Z * HD:
      HS = Z * HS:
      LS = Z * LS:
      MC = Z * MC:
      NL = Z * NL:
      RD = Z * RD:
      RH = Z * RH:
      SL = Z * SL:
      TI = Z * TI:
      XM = Z * XM
```

```
                    +-----------------------------------------+
6000                ! DENSITY CONVERSION (KG/CC <-> LB/CU.IN) !
                    +-----------------------------------------+

6100 Z = 36.1^ L:
     DF = Z * DF:
     DI = Z * DI:
     TD = Z * TD
                              +-----------------------------+
6110                          ! CONVERT UNIT LABELS ALSO    !
                              +-----------------------------+

6150 U1$ = "IN":
     U2$ = "LB":
     U3$ = "SQ.IN":
     U4$ = "CU.IN":
     U5$ = "F":
     U6$ = "LB/CU.IN":
     IF UO$ = "I" THEN
        U1$ = "CM":
        U2$ = "KG":
        U3$ = "SQ.CM":
        U4$ = "CU.CM":
        U5$ = "C":
        U6$ = "GM/CU.CM"
6200 RETURN
                              +-------------------------------+
6208                          ! CONVERT "INFO/<POS>" VALUES   !
                              +-------------------------------+

6210 L = 1 - 2 * (UO$ = "M"):
     PT = (PT - 32 * (L =  - 1)) * 1.8^ L + 32 * (L = 1):
     MP = (MP - 32 * (L =  - 1)) * 1.8^ L + 32 * (L = 1)
6212 Z = 36.1^ L:
     DF = Z * DF:
     DI = Z * DI:
     TD = Z * TD:
     Z = .3937^ L:
     FL = Z * FL:
     HC = Z * HC:
     HD = Z * HD:
     HS = Z * HS:
     SL = Z * SL:
     Z = .061^ L:
     NV = Z * NV:
     RV = Z * RV:
     VG = Z * VG:
     VN = Z * VN
6214 Z = .155^ L:
     AG = Z * AG:
     AN = Z * AN:
     GA = Z * GA:
     NC = Z * NC:
     SN = Z * SN:
     Z = 2.2^ L:
```

```
      IW = Z * IW:
      WT = Z * WT:
      RETURN
                          +-----------------------------------+
6218                      ! CONVERT "DATA<N>/<POS>" VALUES    !
                          +-----------------------------------+
6220  L = 1 - 2 * (UO$ = "M"):
      Z = .061^ L:
      VC = Z * VC:
      VR = Z * VR:
      Z = .155^ L:
      AC = Z * AC:
      NS = Z * NS:
      SC = Z * SC:
      Z = .3937^ L:
      LS = Z * LS:
      NL = Z * NL:
      RD = Z * RD:
      RH = Z * RH:
      TI = Z * TI:
      Z = 2.2^ L:
      CI = CI / Z:
      TW = Z * TW
6223  Z = .155^ L:
      FOR I = 0 TO 9:
         VC(I) = VC(I) * .061^ L:
         AC(I) = Z * AC(I):
         SC(I) = Z * SC(I):
         FOR J = 0 TO 9:
            AJ(I,J) = Z * AJ(I,J):
         NEXT :
      NEXT :
      RETURN
                          +-------------------------------------+
6228                      ! CONVERT COST INFO VALUES FROM DISK !
                          +-------------------------------------+
6230  L = 1 - 2 * (UO$ = "I"):
      Z = 2.2^ L:
      CI = Z * CI:
      CM = Z * CM:
      CR = Z * CR:
      CT = Z * CT:
      Z = .155^ L:
      CC = Z * CC:
      CH = Z * CH:
      CP = CP * .061^ L:
      RETURN
                          +-------------------------------------+
6400                      ! SHRINK AS A FUNCTION OF ALLOY TYPE !
                          +-------------------------------------+
6600  SH = 4:
      RETURN
```

```
                        +---------------------------------+
7000                    !                                 !
7000                    !   END (A) AND LATERAL (B)       !
7000                    ! FEEDING DISTANCES IN INCHES     !
                        +---------------------------------+

7200 IF T < 2 THEN
        A = (1.5 * T + 2 * Q) * FF:
        B = (1.56 * T + .25 * Q) * FF:
        RETURN
7300 A = (1.51 * C + 7.24 * D - 5.67) * FF:
     B = (3.38 * C + .84 * D - 2.34) * FF:
     IF Y THEN
        A = (1.39 * C + 3.16 * D - 3.19) * FF
7400 RETURN
                                    +---------------+
7500                                !  WITH CHILL   !
                                    +---------------+

7600 IF T < 2 THEN
        A = (T + 2.7 * Q) * FF:
        B = (.8 * T + 2.5 * Q) * FF
7700 M = 2.24 * Q + 2.6 * C - 6.02 * D + 6:
     IF T < 2 THEN
        RETURN
7800 A = (4.12 * C + 9.14 * D - 11.4) * FF:
     B = (.88 * T - .76 * Q - 1.64 * C + 10.8 * D + .21 * SQR(M) - 7.04) * FF:
     RETURN
                                       +--+
7900                                   !  !
                                       +--+

8000 G = F * A^ .333:
     G = F * (A + 2 * G)^ .333:
     H = F * B^ .333:
     H = F * (B + 2 * H)^ .333:
     RETURN
                    +-----------------------------------------+
8100                !  TAPER (S) FOR A GIVEN FEEDING DISTANCE  !
                    +-----------------------------------------+

8200 GOSUB 8270:
     S = .0648 * T - .0164 * Q:
     X = (Y - A - B) * S + T
8210 I = X:
     M = W:
     IF W / X > 2 THEN
        M = 2 * X
8220 IF X < 2 THEN
        B = (1.56 * X + .25 * M) * FF:
        GOTO 8240
8230 B = (3.38 * SQR(X) + .84 * SQR(M) - 2.34) * FF:
     GOSUB 8270
8240 X = (Y - A - B) * S + T:
     IF ABS(I - X) > .05 * X THEN 8210
8250 V = ((Y + A - B) * T + (Y + B - A) * X) * W / 2:
```

```
     G = (SH * V / E)^ .333:
     G = (SH * (V + 2 * W * X * G) / E)^ .333:
     RETURN
                                          +--+
8260                                      !  !
                                          +--+
8270 IF Y < (A + B) THEN
        VTAB 18:
        CALL 778:
        PRINT "FOR THAT LENGTH, YOU DON'T NEED TAPER!":
        GOSUB 4000:
        POP :
        POP :
        GOTO 21100
8280 RETURN
                              +-------------------------+
8300                          !                         !
8300                          ! FLUIDITY/ POURING TIME/ !
8300                          !   GATE VOLUME & AREA    !
8300                          !    (IMPERIAL UNITS)     !
                              +-------------------------+
8600 F = .07 * PT - 178:
     FL = F:
     RETURN
8650 F = .126 * PT - 175.8:
     FL = 2.54 * F:
     RETURN :                             !  PT IN DEG C
8700 TP = (1.733 - .116 * LOG(W)) * SQR(W):
     R = SN / 6 / VN^ .6667:
     Z = LOG(VN * DF) / LOG(10) + 0.3433 * (UO$ = "M"):
     VG = .01 * VN * (26.75 - 14.5774 * Z + 2.9643 * Z * Z - 0.2083 * Z^ 3) * (
     1 + LOG(R) * (R > 1))
8800 GA = 1.65 * V * GS / F / TP / SQR(D):
     SD = 2 * SQR(GA / GS / PI):
     RETURN
                                          +--+
8900                                      !  !
                                          +--+
9000 CALL  - 958:
     INVERSE :
     HTAB 1:
     PRINT "NAME OF DISK FILE: ";:
     NORMAL :
     PRINT S$;:
     N% = 0:
     GOSUB 1000:
     IF Q$ = "" THEN
        POP :
        GOTO 12700
9100 F$ = Q$:
     RETURN
9200 PRINT D$"OPEN "F$:
```

```
      PRINT D$"READ "F$:
      RETURN
 9300 PRINT D$"OPEN "F$",D"DD:
      PRINT D$"WRITE "F$:
      RETURN
 9400 PRINT CHR$(4)"CLOSE ":
      RETURN
 9500 PRINT D$"VERIFY "F$",D"DD:
      ONERR GOTO 48880
 9600 RETURN
                                          +--+
 9700                                     !  !
                                          +--+
 9800 IF PO$ <  > " " THEN
         RETURN
 9900 VTAB 3:
      HTAB 1:
      CALL  - 958:
      CALL 778:
      VTAB 8:
      PRINT "     CANNOT "A$" DATA UNTIL ":
      VTAB 10:
      HTAB 8:
      FLASH :
      PRINT " PURCHASE ORDER # ":
      NORMAL :
      VTAB 12:
      PRINT "IS ENTERED IN CUSTOMER/CASTING INFO!":
      CALL 778:
      GOSUB 4000:
      POP :
      GOTO 12700
                                          +--+
10000                                     !  !
                                          +--+
10100 R$ = STR$(RN):
      IF RN < 10 GOTO 10300
10150 INVERSE :
      PRINT "RISER NUMBER (0-9): ";:
      NORMAL :
      PRINT " ";
10200 GOSUB 250:
      R = ASC(R$):
      IF R = 13 THEN
         PRINT :
         CALL 778:
         POP :
         POP :
         GOTO 12700
10250 IF R < 46 OR R > 57 THEN
         CALL 778:
         GOTO 10200
```

```
10260 PRINT R$
10300 RN = VAL(R$):
      F$ = "DATA" + R$ + "/" + LEFT$(PO$,20):
      RETURN
                                          +--+
10350                                     !  !
                                          +--+
10400 GOSUB 9500:
      GOSUB 9200:
      INPUT R$,AC,CI,CN,CS,LS,NL,NS,NR,RD,RH,RT,SA,SC,SR,TI,TW,VC,VR:
      FOR L = 0 TO 9:
         INPUT AC(L),CN(L),SC(L),VC(L):
      NEXT
10500 FOR L = 0 TO 9:
         FOR J = 0 TO 9:
            INPUT AJ(L,J):
         NEXT :
      NEXT :
      GOSUB 9400:
      ON R$ <  > U0$ GOSUB 6220:
      RETURN
                              +--------------------------+
12600                         !  **** MAIN PROGRAM ****  !
                              +--------------------------+
12610 POKE 51,128:
      ON P% > 0 GOTO 12700:
      D$ = CHR$(13) + CHR$(4):
      S$ = " ":
      X$ = "          ":
      PI = 3.14159:
      DEF FN P1(R) = INT(R * 10 + .5) / 10:
      DEF FN P2(R) = INT(R * 100 + .5) / 100:
      DEF FN P3(R) = INT(R * 1000 + .5) / 1000
12630 HOME :
      VTAB 10:
      CALL  - 958:
      HTAB 9:
      PRINT "PROGRAM IS LOADED":
      PRINT D$"OPEN SCRATCH1,V222":
      PRINT D$"READ SCRATCH1"
12635 CALL 917:
      INPUT CA$:
      CALL 917:
      INPUT CC$:
      CALL 917:
      INPUT CD$:
      CALL 917:
      INPUT CN$:
      CALL 917:
      INPUT DT$:
      CALL 917:
      INPUT PO$
```

```
12640 CALL 917:
      INPUT UN$:
      CALL 917:
      INPUT MM$:
      CALL 917:
      INPUT Q$:
      P$(0) = CHR$(VAL(Q$)):
      FOR I = 1 TO 8:
         CALL 917:
         INPUT M$(I):
         CALL 917:
         INPUT Q$:
         P$(I) = CHR$(VAL(Q$)):
      NEXT
12645 INPUT CI,CS,DD,DI,FF,MP,MW,NL,NS,P%,PT,RD,RH,RT,SA,SH,TD,TI,TW,VR,XM
12650 PRINT D$"OPEN SCRATCH2,V222":
      PRINT D$"READ SCRATCH2":
      INPUT U0$,U1$,U2$,U3$,U4$,U5$,U6$,AC,AN,CN,DF,IC,IW,LS,MM,N,NC,NN,NR,NV,RN
      ,RV,SC,SL,SN,SP,SR,SS,VC,VN,WT:
      FOR I = 0 TO 9:
         INPUT AC(I),CN(I),SC(I),VC(I):
      NEXT
12660 FOR I = 0 TO 9:
         FOR J = 0 TO 9:
            INPUT AJ(I,J):
         NEXT :
      NEXT :
      PRINT D$"OPEN SCRATCH3,V222":
      PRINT D$"READ SCRATCH3":
      INPUT AG,CC,CH,CM,CP,CR,CT,FL,GA,GS,HC,HD,HS,NA,NG,TP,VG,WG:
      PRINT D$"CLOSE"
                                          +--+
12670                                     !  !
                                          +--+
12700 POKE 34,0:
      HOME :
      INVERSE :
      PRINT " MAIN MENU FOR CANMET RISERING: ":
      PRINT SPC( 32)"":
      NORMAL :
      VTAB 5:
      I = FRE(0):
      P = 0:
      ONERR GOTO 48880
12800 PRINT "  1. INSTRUCTIONS":
      PRINT :
      PRINT "  2. CUSTOMER/CASTING INFO":
      PRINT :
      PRINT "  3. FEEDING DISTANCE"
12900 PRINT :
      PRINT "  4. CASTING SHAPE/SIZE":
      PRINT :
```

```
      PRINT "  5. RISER SIZE/NECK":
      PRINT :
      PRINT "  6. GATING SYSTEM"
13000 PRINT :
      PRINT "  7. COST ANALYSIS":
      PRINT :
      PRINT "  8. QUIT/STORE FILES ON DISK":
      PRINT :
      PRINT :
      L% = 8:
      GOSUB 3200
13100 ON R% GOTO 48610,13500,19900,24300,24500,36600,41800,46600
                          +----------------------------------+
13400                     !  *** CUSTOMER/CASTING INFO ***  !
                          +----------------------------------+
13500 POKE 34,0:
      HOME :
      HTAB 4:
      INVERSE :
      PRINT "  CUSTOMER/CASTING INFORMATION  ":
      HTAB 4:
      PRINT SPC( 32)"":
      NORMAL :
      I = FRE(0)
13510 POKE 34,3:
      VTAB 4:
      PRINT "GET THIS INFORMATION FROM DISK? ";:
      GOSUB 2900:
      CALL  - 958:
      IF R$ <  > "Y" GOTO 14100
13550 VTAB 5:
      INVERSE :
      PRINT "PURCHASE ORDER #: ";:
      NORMAL :
      N% = 0:
      GOSUB 1000:
      ON L% = 1 GOTO 12700:
      F$ = Q$:
      D% = 1:
      ONERR GOTO 48940
13700 F$ = "INFO/" + LEFT$(F$,20):
      GOSUB 9500:
      GOSUB 9200
13800 CALL 917:
      INPUT R$:
      CALL 917:
      INPUT CA$:
      CALL 917:
      INPUT CC$:
      CALL 917:
      INPUT CD$:
      CALL 917:
```

```
      INPUT CN$:
      CALL 917:
      INPUT DT$:
      CALL 917:
      INPUT MM$:
      CALL 917:
      INPUT PO$:
      CALL 917:
      INPUT UN$
13900 INPUT AG,AN,DF,DI,FF,FL,GA,GS,HC,HD,HS,IC,IW,MM,MP,MW,NA,NC,NG,NV,PT,RV,SH
      ,SL,SN,SP,SS,TD,TP,VG,VN,WT:
      GOSUB 9400:
      HOME :
      IF R$ <  > U0$ THEN
         GOSUB 6210:
         GOSUB 5000:
         U0$ = R$
                                              +--+
14000                                         !  !
                                              +--+
14100 HOME :
      INVERSE :
      VTAB 5:
      PRINT "CUSTOMER NAME: ":
      VTAB 8:
      PRINT "CUSTOMER ADDRESS: ":
      VTAB 11:
      PRINT "CUSTOMER CITY/PROV: ":
      VTAB 14:
      PRINT "CASTING DESCRIPTION: "
14150 VTAB 17:
      PRINT "PURCHASE ORDER #: ":
      VTAB 19:
      PRINT "TODAY'S DATE: ":
      VTAB 21:
      PRINT "YOUR NAME: ":
      NORMAL :
      ON CN$ <  > " " OR PO$ <  > " " OR CD$ <  > " " GOTO 15400
14400 N% = 0:
      VTAB 5:
      HTAB 17:
      GOSUB 1000:
      IF L% > 1 THEN
         CN$ = Q$
14500 Q$ = CN$:
      VTAB 5:
      L% = 17:
      I = 120:
      GOSUB 300
14600 VTAB 8:
      HTAB 20:
      GOSUB 1000:
```

```
      IF L% > 1 THEN
         CA$ = Q$
14700 Q$ = CA$:
      VTAB 8:
      L% = 20:
      I = 120:
      GOSUB 300
14800 VTAB 11:
      HTAB 22:
      GOSUB 1000:
      IF L% > 1 THEN
         CC$ = Q$
14900 Q$ = CC$:
      VTAB 11:
      L% = 22:
      I = 120:
      GOSUB 300
14910 VTAB 14:
      HTAB 23:
      GOSUB 1000:
      IF L% > 1 THEN
         CD$ = Q$
14920 Q$ = CD$:
      VTAB 14:
      L% = 23:
      I = 120:
      GOSUB 300
15000 VTAB 17:
      HTAB 20:
      GOSUB 1000:
      IF L% > 1 THEN
         PO$ = Q$
15100 Q$ = PO$:
      VTAB 17:
      L% = 20:
      I = 80:
      GOSUB 300
15200 VTAB 19:
      HTAB 16:
      GOSUB 1000:
      IF L% > 1 THEN
         DT$ = Q$
15300 Q$ = DT$:
      VTAB 19:
      L% = 16:
      I = 80:
      GOSUB 300
15310 VTAB 21:
      HTAB 13:
      GOSUB 1000:
      IF L% > 1 THEN
         UN$ = Q$
```

```
15320 Q$ = UN$:
      VTAB 21:
      L% = 13:
      I = 80:
      GOSUB 300:
      GOTO 15600
15400 VTAB 5:
      HTAB 16:
      PRINT S$CN$:
      VTAB 8:
      HTAB 20:
      PRINT CA$:
      VTAB 11:
      HTAB 22:
      PRINT CC$:
      VTAB 14:
      HTAB 23:
      PRINT CD$:
      VTAB 17:
      HTAB 20:
      PRINT PO$:
      VTAB 19:
      HTAB 16:
      PRINT DT$:
      VTAB 21:
      HTAB 13:
      PRINT UN$
15600 GOSUB 2800:
      IF R$ = "Y" THEN
         GOSUB 3150:
         GOTO 14400
                                          +---+
15700                                     !   !
                                          +---+
15750 HOME :
      INVERSE :
      VTAB 5:
      PRINT "UNITS? IMPERIAL OR METRIC: ":
      VTAB 8:
      PRINT "POURING TEMPERATURE ("U5$"): ":
      VTAB 11:
      PRINT "SOLID'N TEMPERATURE ("U5$"):  ":
      VTAB 14:
      PRINT "FEED METAL SHRINKAGE (%): "
15760 VTAB 18:
      PRINT "HOT TOPPING DENSITY ("U6$"): ":
      VTAB 21:
      PRINT "TOP INSUL'N DENSITY ("U6$"): "
15780 VTAB 5:
      HTAB 8:
      FLASH :
      PRINT "I";:
```

```
      HTAB 20:
      PRINT "M";:
      NORMAL :
      HTAB 29:
      PRINT U0$:
      VTAB 8:
      HTAB 28:
      PRINT INT(PT):
      VTAB 11:
      HTAB 28:
      PRINT INT(MP):
      VTAB 14:
      HTAB 29:
      PRINT SH
15800 A = 1 + 999 * (U0$ = "M"):
      VTAB 18:
      HTAB 34:
      PRINT FN P3(TD * A):
      VTAB 21:
      HTAB 33:
      L% = 6:
      D% = 4:
      R = DI * A:
      GOSUB 4300:
      HTAB 33:
      PRINT S$:
      GOTO 17600
16200 VTAB 5:
      HTAB 29:
      GET R$:
      IF R$ = CHR$(13) THEN
         PRINT R$:
         GOTO 16900
16300 IF R$ = "I" OR R$ = "i" THEN
         R$ = "I":
         GOTO 16600
16400 IF R$ = "M" OR R$ = "m" THEN
         R$ = "M":
         GOTO 16600
16500 CALL 778:
      GOTO 16200
16600 ON U0$ <  > R$ GOSUB 5000:
      HTAB 29:
      CALL  - 868:
      PRINT R$:
      U0$ = R$
16900 A = 1 + 999 * (U0$ = "M"):
      VTAB 8:
      HTAB 22:
      INVERSE :
      PRINT U5$;:
      NORMAL :
```

```
      HTAB 28:
      PRINT INT(PT)X$:
      VTAB 11:
      HTAB 22:
      INVERSE :
      PRINT U5$;:
      NORMAL :
      HTAB 28:
      PRINT INT(MP)X$
16950 VTAB 18:
      HTAB 22:
      INVERSE :
      PRINT U6$:
      VTAB 21:
      HTAB 22:
      PRINT U6$:
      NORMAL :
      VTAB 18:
      HTAB 34:
      PRINT FN P3(TD * A);X$:
      VTAB 21:
      HTAB 33:
      L% = 6:
      R = DI * A:
      GOSUB 4300:
      HTAB 33:
      PRINT S$
17000 N% = 1:
      VTAB 8:
      HTAB 28:
      R = PT:
      GOSUB 1000:
      IF R < > PT THEN
         PT = R:
         PRINT X$
17100 VTAB 11:
      HTAB 28:
      R = MP:
      GOSUB 1000:
      IF R < > MP THEN
         MP = R:
         PRINT X$
17110 GOSUB 6600:
      VTAB 14:
      HTAB 29:
      PRINT SH;X$
17150 VTAB 14:
      HTAB 29:
      R = SH:
      GOSUB 1000:
      IF R < > SH THEN
         SH = R:
```

```
         PRINT X$
17200 VTAB 18:
      HTAB 34:
      R = TD * A:
      GOSUB 1000:
      IF ABS(R - TD * A) > .001 * R THEN
         TD = R / A:
         PRINT X$
17300 VTAB 21:
      HTAB 34:
      R = DI * A:
      GOSUB 1000:
      IF ABS(R - DI * A) > .001 * R THEN
         DI = R / A:
         PRINT X$
17600 GOSUB 2800:
      IF R$ = "Y" THEN
         GOSUB 3150:
         GOTO 16200
                                          +---+
17700                                     !   !
                                          +---+
17800 HOME :
      VTAB 8:
      PRINT "MOLDING MATERIAL IS ":
      PRINT :
      INVERSE :
      HTAB 10:
      PRINT MM$:
      VTAB 15:
      NORMAL :
      PRINT "DO YOU WISH TO CHANGE IT? ";:
      GOSUB 2900:
      IF R$ <  > "Y" THEN 19200
17900 HOME :
      VTAB 6:
      PRINT "   CHOICE OF MOLDING MATERIALS:":
      VTAB 9:
      PRINT "      1. SILICA SAND":
      PRINT :
      PRINT "      2. OLIVINE SAND":
      PRINT :
      PRINT "      3. CHROMITE SAND":
      PRINT :
      PRINT "      4. ZIRCON SAND"
18000 PRINT :
      PRINT :
      PRINT "   ";:
      L% = 4:
      GOSUB 3200:
      ON R% GOTO 18100,18200,18300,18400
18100 FF = 1.0:
```

```
      MW = 3.0:
      MM$ = "SILICA SAND ":
      GOTO 18500
18200 FF = .96:
      MW = 2.0:
      MM$ = "OLIVINE SAND ":
      GOTO 18500
18300 FF = .87:
      MW = 1.5:
      MM$ = "CHROMITE SAND ":
      GOTO 18500
18400 FF = .90:
      MW = 0.5:
      MM$ = "ZIRCON SAND "
18500 HOME :
      VTAB 6:
      PRINT "   CHOICE OF MOLDING PROCESS:":
      VTAB 9:
      PRINT "      1. GREEN":
      PRINT :
      PRINT "      2. DRY":
      PRINT :
      PRINT "      3. NOBAKE":
      PRINT :
      PRINT "      4. SHELL":
      PRINT :
      PRINT :
      PRINT "   ";
18600 L% = 4:
      GOSUB 3200:
      ON R% GOTO 18700,18800,18900,19000
18700 MW = MW * 1.0:
      MM$ = " GREEN " + MM$:
      GOTO 19200
18800 MW = MW * 1.0:
      MM$ = " DRY " + MM$:
      GOTO 19200
18900 MW = MW * 0.5:
      MM$ = " NOBAKE " + MM$:
      GOTO 19200
19000 MW = MW * 0.2:
      MM$ = " SHELL " + MM$:
      GOTO 12700

                                        +---+
19100                                   !   !
                                        +---+

19200 HOME :
      VTAB 8:
      PRINT "GET SECTION/RISER DATA FROM DISK? ";:
      GOSUB 2900:
      ON R$ <  > "Y" GOTO 12700:
      A$ = " LOAD":
```

```
      GOSUB 9800:
      Dx = 4:
      ONERR GOTO 48940
19400 VTAB 14:
      GOSUB 10150:
      GOSUB 10400
19500 AN = 0:
      IC = 0:
      IW = 0:
      MC = 0:
      MM = 0:
      NC = 0:
      NV = 0:
      RV = 0:
      SL = 0:
      SN = 0:
      SP = 0:
      SS = 0:
      VN = 0:
      WT = 0:
      GOTO 12700
                          +-----------------------------+
19800                     !  *** FEEDING DISTANCE ***  !
                          +-----------------------------+
19900 HOME :
      HTAB 7:
      INVERSE :
      PRINT "   FEEDING DISTANCE   ":
      POKE 34,1:
      I = FRE(0):
      T = 0:
      W = 0:
      Z = 1:
      IF U0$ = "M" THEN
         Z = 2.54
20000 HOME :
      HTAB 7:
      INVERSE :
      PRINT SPC( 22)"":
      NORMAL :
      VTAB 7:
      INVERSE :
      PRINT "EFFECTIVE SECTION THICKNESS ("U1$"):":
      VTAB 10:
      PRINT "EFFECTIVE SECTION WIDTH     ("U1$"):":
      NORMAL
20100 IF T THEN
         VTAB 7:
         HTAB 35:
         PRINT FN P2(T * Z):
         VTAB 10:
         HTAB 35:
```

```
         PRINT FN P2(W * Z):
         GOSUB 3150
20200 N% = 1:
      VTAB 7:
      HTAB 35:
      R = T * Z:
      GOSUB 1000:
      IF R < > T * Z THEN
         T = R / Z:
         PRINT X$
20500 VTAB 10:
      HTAB 35:
      R = W * Z:
      GOSUB 1000:
      IF R < > W * Z THEN
         W = R / Z:
         PRINT X$
20600 IF T > W THEN
         C = T:
         T = W:
         W = C
20700 R = W / T:
      Q = W:
      IF R > 2 THEN
         Q = 2 * T
20800 C = SQR(T):
      D = SQR(Q):
      E = 3 * PI * (20 - SH):
      F = (T * W * SH / E)^ .333
20900 IF T < 2 THEN
         VTAB 17:
         HTAB 1:
         CALL 778:
         PRINT "TREAT THE FOLLOWING VALUES WITH CAUTION":
         PRINT :
         PRINT "GATING HAS A SIGNIFICANT EFFECT ON":
         PRINT :
         PRINT "FEEDING DISTANCE FOR THICKNESS < ";INT(Z * 2);S$U1$
21000 GOSUB 4000
21100 VTAB 3:
      CALL  - 958:
      VTAB 7:
      PRINT "   1. NO CHILLS OR TAPER":
      VTAB 9:
      PRINT "   2. END OR DRAG CHILLS":
      VTAB 11:
      PRINT "   3. TAPERED SECTION (PADDING)":
      VTAB 13:
      PRINT "   4. NEW SECTION SIZE"
21200 VTAB 15:
      PRINT "   5. ";:
      INVERSE :
```

```
      PRINT "PRINT";:
      NORMAL :
      PRINT " SIZE/DISTANCE TABLE ENTRY":
      VTAB 17:
      PRINT "   6. RETURN TO MAIN MENU":
      VTAB 21:
      L% = 6:
      GOSUB 3200:
      L = 0
21300 ON R% GOTO 21400,21500,21600,20000,21900,12700
21400 M = 0:
      A$ = " TOWARDS":
      Q$ = "ANOTHER RISER":
      R$ = "  NO CHILLS OR TAPER  ":
      GOSUB 22800:
      GOSUB 7200:
      GOSUB 8000:
      GOSUB 23200:
      GOSUB 23400:
      GOSUB 4000:
      GOTO 21100
                                          +--+
21450                                     !  !
                                          +--+
21500 A$ = "TO EDGE OF":
      Q$ = " DRAG CHILL":
      R$ = "  END OR DRAG CHILLS  ":
      GOSUB 22800:
      GOSUB 7600:
      GOSUB 8000:
      GOSUB 23200:
      GOSUB 23400:
      GOSUB 4000:
      GOTO 21100
                                          +--+
21550                                     !  !
                                          +--+
21600 R$ = "   TAPERED SECTION    ":
      GOSUB 22800:
      NORMAL :
      VTAB 10:
      PRINT "LENGTH TO BE FED ("U1$"): ";:
      R = 0:
      N% = 1:
      GOSUB 1000:
      Y = R / Z:
      PRINT
21650 IF NOT CP THEN
         VTAB 14:
         PRINT "COST OF GRINDING OFF PADS ($/"U4$"): ";:
         R = 0:
         PRINT :
```

```
        HTAB 19:
        GOSUB 1000:
        CP = R:
        PRINT
21700 GOSUB 7200:
      GOSUB 8200:
      GOSUB 23200
21750 VTAB 6:
      PRINT " TAPER: ";:
      L% = 5:
      D% = 3:
      R = S:
      GOSUB 4300:
      PRINT S$U1$"/"U1$;:
      INVERSE :
      HTAB 23:
      PRINT "LENGTH:";:
      NORMAL
21760 R = Y * Z:
      L% = 7:
      D% = 2:
      GOSUB 4300:
      PRINT S$U1$:
      VTAB 9:
      PRINT "TAPER STARTS";:
      D% = 1:
      R = A * Z:
      GOSUB 4300:
      PRINT S$U1$"  FROM END"
21800 PRINT "   AND STOPS  ";:
      R = B * Z:
      GOSUB 4300:
      PRINT S$U1$"  FROM RISER":
      VTAB 12:
      PRINT "   THICKNESS AT RISER IS  ";:
      R = X * Z:
      GOSUB 4300:
      PRINT S$U1$:
      PRINT "APPROXIMATE RISER RADIUS  ";:
      R = G * Z:
      GOSUB 4300:
      PRINT S$U1$
21850 V = (V - T * W * L) * Z^ 3:
      VTAB 15:
      PRINT "VOLUME TO BE GROUND OFF:  ";INT(V);S$U4$:
      HTAB 12:
      PRINT "AT A COST OF: $";INT((CP + CM * DF) * V):
      GOSUB 4000:
      GOTO 21100
                                        +--+
21860                                   !  !
                                        +--+
```

```
21900 L% = 6:
      PRINT D$"PR# "P%:
      ON P > 0 GOTO 22400:
      P = 1:
      PRINT P$(0)P$(1):
      PRINT :
      PRINT :
      PRINT SPC( 20)"FEEDING DISTANCE TABLE  ("U1$")  FOR  LOW CARBON STEEL IN "
      M$
22100 PRINT :
      PRINT "     +";:
      FOR I = 1 TO 110:
         PRINT "-";:
      NEXT :
      PRINT "+"
22200 PRINT "     !   SECTION SIZE    !      NO CHILLS      !              END OR
      DRAG CHILLS              !    TAPERED SECTION    !"
22250 PRINT "     !                   !   END     LATERAL  !   END     LATERAL
           CHILL    DRAG CHILL ! REQUIRED   UNTAPERED  !"
22300 PRINT "     ! THICKNESS   WIDTH ! DISTANCE  DISTANCE ! DISTANCE  DISTANCE
         THICKNESS    LENGTH   !  SLOPE     END LENGTH !"
22350 PRINT "     !-------------------!--------------------!--------------------
      -------------------------!-----------------------!"
22400 D% = 2:
      PRINT "     ! ";:
      R = T * Z:
      GOSUB 4300:
      PRINT "    ";:
      R = W * Z:
      GOSUB 4300:
      PRINT "  !  ";:
      GOSUB 7200:
      R = A * Z:
      D% = 1:
      GOSUB 4300:
      PRINT "    ";
22450 R = B * Z:
      GOSUB 4300:
      PRINT "  !  ";:
      GOSUB 7600:
      R = A * Z:
      GOSUB 4300:
      PRINT "    ";:
      R = B * Z:
      GOSUB 4300:
      PRINT SPC( 7):
      R = .6 * T * Z:
      GOSUB 4300:
      PRINT "     ";
22500 R = H * Z:
      GOSUB 4300:
      PRINT "   !  ";:
```

```
      R = .0648 * T - .0164 * Q:
      D% = 3:
      GOSUB 4300:
      PRINT "     ";:
      R = (1.39 * C + 3.16 * D - 3.19) * FF * Z:
      D% = 1:
      GOSUB 4300:
      PRINT "    !"
22600 PRINT "     !.................!.................!.................
      .........................!.......................!":
      PRINT CHR$(4)"PR#0":
      GOTO 21100
                                        +---------+
22700                                   !  SUBS   !
                                        +---------+

22800 HOME :
      HTAB 7:
      INVERSE :
      PRINT R$:
      NORMAL :
      RETURN
                                          +--+
23100                                     !  !
                                          +--+

23200 VTAB 4:
      CALL  - 958:
      INVERSE :
      PRINT "THICKNESS:";:
      NORMAL :
      L% = 7:
      D% = 2:
      R = T * Z:
      GOSUB 4300:
      PRINT S$U1$;:
      HTAB 24:
      INVERSE :
      PRINT "WIDTH:";:
      NORMAL :
      R = W * Z:
      GOSUB 4300:
      PRINT S$U1$:
      RETURN
                                          +--+
23300                                     !  !
                                          +--+

23400 VTAB 7:
      HTAB 19:
      PRINT "TOWARDS   "A$:
      HTAB 19:
      PRINT "AN END    "Q$:
      L% = 4:
      D% = 1
```

```
23500 VTAB 10:
      PRINT "FEEDING DISTANCE";:
      HTAB 19:
      R = A * Z:
      GOSUB 4300:
      PRINT S$U1$;:
      HTAB 30:
      R = B * Z:
      GOSUB 4300:
      PRINT S$U1$:
      HTAB 7:
      PRINT "FROM RISER"
23600 VTAB 13:
      INVERSE :
      PRINT "APPROX.";:
      NORMAL :
      PRINT " RADIUS";:
      HTAB 19:
      R = G * Z:
      GOSUB 4300:
      PRINT S$U1$;:
      HTAB 30:
      R = H * Z:
      GOSUB 4300:
      PRINT S$U1$:
      HTAB 7:
      PRINT "OF RISER":
      IF NOT M THEN
         RETURN
23700 VTAB 19:
      PRINT "SUGGESTED CHILL THICKNESS IS  ";:
      R = .6 * T * Z:
      GOSUB 4300:
      PRINT S$U1$:
      VTAB 21:
      PRINT "MAX. LENGTH FOR DRAG CHILL IS  ";:
      R = M * Z:
      GOSUB 4300:
      PRINT S$U1$:
      RETURN
                          +-------------------------------+
24200                     !  *** CASTING SHAPE/SIZE ***   !
                          +-------------------------------+
24300 ON VC = 0 GOTO 48620:
      HOME :
      HTAB 5:
      INVERSE :
      PRINT "  CASTING SHAPE/SIZE  ":
      HTAB 5:
      PRINT SPC( 22)"":
      NORMAL :
      VTAB 5:
```

```
      I = FRE(0)
24304 CALL 778:
      PRINT "DATA ALREADY EXISTS FOR THIS SECTION!":
      PRINT :
      PRINT "DO YOU WANT TO:":
      VTAB 10:
      PRINT "   1. ERASE THE DATA":
      VTAB 13:
      PRINT "   2. STORE THE DATA ON DISK":
      VTAB 16:
      PRINT "   3. CARRY ON REGARDLESS"
24305 VTAB 19:
      PRINT "   4. RETURN TO MAIN MENU":
      VTAB 22:
      L% = 4:
      GOSUB 3200:
      ON R% GOTO 24310,24320,48620,12700
24310 PRINT :
      HTAB 10:
      PRINT "ERASE? ";:
      GOSUB 2900:
      ON R$ <  > "Y" GOTO 12700:
      GOSUB 48200:
      GOTO 48620
24320 GOSUB 47750:
      GOTO 48620
                          +---------------------------+
24400                     !  *** RISER SIZE/NECK ***  !
                          +---------------------------+
24500 HOME :
      HTAB 7:
      INVERSE :
      PRINT "  RISER SIZE/NECK  ":
      HTAB 7:
      PRINT SPC( 19)"":
      NORMAL
24550 VTAB 5:
      HTAB 7:
      PRINT "SUB-   WEIGHT  MODULUS":
      HTAB 5:
      PRINT "SECTION   ("U26")     ("U16")":
      PRINT :
      AC = 0:
      CN = 0:
      MC = 0:
      NN = 0:
      SC = 0:
      VC = 0:
      L% = 6:
      Q = 0:
      FOR I = 0 TO 9:
         IF VC(I) = 0 OR SC(I) = 0 GOTO 24650
```

```
24600     AC = AC + AC(I):
          CN = CN + CN(I):
          SC = SC + SC(I):
          VC = VC + VC(I):
          NN = NN + 1:
          HTAB 9:
          PRINT I;:
          HTAB 13:
          D% = 1:
          R = VC(I) * DF:
          GOSUB 4300:
          HTAB 22:
          R = VC(I) / SC(I):
          D% = 2:
          GOSUB 4300:
          PRINT :
          IF R > Q THEN
             Q = R:
             SR = I
24650 NEXT :
      ON VC > 0 GOTO 24700:
      VTAB 10:
      CALL 778:
      PRINT "CANNOT FIND RISER SIZE UNTIL AFTER":
      PRINT
24660 HTAB 6:
      FLASH :
      PRINT " CASTING SHAPE/SIZE ":
      NORMAL :
      PRINT :
      PRINT "   OPTION HAS BEEN COMPLETED.":
      CALL 778:
      PRINT :
      GOSUB 4000:
      GOTO 12700
24700 ON NN = 1 GOTO 48650:
      PRINT :
      PRINT :
      PRINT "   THERE ARE ";:
      INVERSE :
      PRINT S$NN;S$;:
      NORMAL :
      PRINT " SUB-SECTIONS.":
      PRINT :
      PRINT "ON WHICH SUB-SECTION":
      PRINT "WILL THE RISER BE PLACED? "SR;CHR$(8);
24750 R = SR:
      N% = 1:
      GOSUB 1000:
      SR = R:
      IF VC(R) = 0 THEN
         CALL 778:
```

```
        HTAB 27:
        CALL  - 958:
        GOTO 24750
25000 GOTO 48650

                              +-------------------------+
36500                         !  *** GATING SYSTEM ***  !
                              +-------------------------+

36600 HOME :
      HTAB 8:
      INVERSE :
      PRINT "  GATING SYSTEM  ":
      HTAB 8:
      PRINT SPC( 17)"":
      NORMAL :
      I = FRE(0):
      POKE 34,3
36700 VTAB 5:
      INVERSE :
      PRINT "GATE/SPRUE AREA RATIO: ":
      VTAB 8:
      PRINT "SPRUE HEIGHT ("U16"):"SPC( 9)"":
      VTAB 11:
      PRINT "PATTERN HT. IN COPE ("U16"):  ":
      VTAB 14:
      PRINT "PATTERN DEPTH IN DRAG ("U16"):"
36800 VTAB 17:
      PRINT "TOTAL NUMBER OF GATES:        ":
      VTAB 20:
      PRINT "# GATES ATTACHED TO CASTING:  ":
      NORMAL :
      VTAB 5:
      HTAB 25:
      PRINT GS:
      IF NOT NG THEN 36900
36850 VTAB 8:
      HTAB 29:
      PRINT FN P1(HS):
      VTAB 11:
      HTAB 29:
      PRINT FN P1(HC):
      VTAB 14:
      HTAB 29:
      PRINT FN P1(HD):
      VTAB 17:
      HTAB 32:
      PRINT NG:
      VTAB 20:
      HTAB 32:
      PRINT NA:
      GOTO 37600
36900 N% = 1:
      VTAB 5:
```

```
      HTAB 25:
      R = GS:
      GOSUB 1000:
      IF R < > GS THEN
         GS = R:
         PRINT XS
37000 VTAB 8:
      HTAB 29:
      R = HS:
      GOSUB 1000:
      IF R < > HS THEN
         HS = R:
         PRINT XS
37100 VTAB 11:
      HTAB 29:
      R = HC:
      GOSUB 1000:
      IF R < > HC THEN
         HC = R:
         PRINT XS
37200 VTAB 14:
      HTAB 29:
      R = HD:
      GOSUB 1000:
      IF R < > HD THEN
         HD = R:
         PRINT XS
37300 VTAB 17:
      HTAB 32:
      R = NG:
      GOSUB 1000:
      IF R < > NG THEN
         NG = R:
         PRINT XS
37400 VTAB 20:
      HTAB 32:
      R = NA:
      GOSUB 1000:
      IF R > NG THEN
         HTAB 32:
         PRINT NA;X$;:
         CALL 778:
         GOTO 37400
37500 IF NA < > R THEN
         NA = R:
         PRINT XS
37600 GOSUB 2800:
      IF R$ = "Y" THEN
         GOSUB 3150:
         GOTO 36900
37700 D = HS - .5 * HC * HC / (HC + HD):
      IF UO$ = "I" THEN
```

```
         GOSUB 8600:
         GOTO 37900
37750 GOSUB 8650
37900 HOME :
      HTAB 5:
      INVERSE :
      PRINT " SUM OF RISERED SECTIONS ":
      HTAB 5:
      PRINT SPC( 25)"":
      NORMAL :
      I = FRE(0):
      VTAB 12:
      PRINT "HAVE ALL SECTION RISERS BEEN ANALYSED?":
      VTAB 14:
      PRINT "     AND STORED ON DISK? ";
37950 GOSUB 2900:
      IF R$ <  > "Y" THEN
         VTAB 17:
         PRINT " THE GATING SYSTEM DESIGN REQUIRES THE   SUMMATION OF ALL LIQUID
          METAL IN THE    CASTING, AS STORED IN THE DISK FILES.":
         GOSUB 4000:
         GOTO 12700
38300 A$ = "LOAD":
      GOSUB 9800:
      HTAB 1:
      VTAB 10:
      CALL  - 958:
      INVERSE :
      PRINT "PLEASE WAIT WHILE SECTIONS ARE SUMMED:":
      NORMAL :
      PRINT :
      PRINT "   LOADING DATA FOR RISER:":
      I = 0:
      MM = 0:
      SS = 0
38400 F$ = "DATA" + STR$(I) + "/" + LEFT$(PO$,20):
      ONERR GOTO 41400
38410 GOSUB 10400:
      VTAB 12 + I:
      HTAB 28:
      PRINT I
38500 B = PI * RD * RD / 4:
      AN = AN + NR * NS:
      MM = MM + NR:
      NC = NC + NR * AC:
      NV = NV + NR * NL * NS:
      RV = RV + NR * VR:
      SN = SN + NR * SC:
      SS = SS + NR * (RT < 5):
      VN = VN + NR * VC
38600 A = NR * DI * TI * B * (RT = 2):
      IC = IC + A * CI:
```

```
      IW = IW + A:
      SL = SL + NR * LS:
      SP = SP + NR * CS:
      WT = WT + NR * TW * (RT = 1 OR RT = 5)
38700 I = I + 1:
      ON I < 10 GOTO 38400:
      ONERR GOTO 48880
38800 ON VN = 0 GOTO 12700:
      HOME :
      INVERSE :
      VTAB 8:
      PRINT "POURING TIME (SECONDS): ":
      VTAB 11:
      PRINT "FLUIDITY OF STEEL ("U1$"): ":
      VTAB 14:
      PRINT "SPRUE BASE DIAMETER ("U1$"):  "
38810 VTAB 17:
      PRINT "NET AREA OF GATES ("U3$"): ":
      VTAB 20:
      PRINT "WEIGHT OF GATING SYSTEM ("U2$"): ":
      NORMAL
38850 VTAB 11:
      HTAB 26:
      PRINT FN P1(FL):
      V = VN:
      W = VN * DF:
      IF UO$ = "M" THEN
         W = W * 2.2:
         D = D / 2.54:
         V = V * .061
39000 GOSUB 8700:
      IF UO$ = "M" THEN
         GA = GA * 6.45:
         SD = SD * 2.54
39100 AG = GA * NA / NG:
      WG = VG * DF
39200 VTAB 4:
      PRINT "  WEIGHT OF CASTING  ("U2$"):  ";INT(VN * DF):
      PRINT "  MODULUS OF CASTING ("U1$"):  ";FN P2(VN / SN):
      VTAB 8:
      HTAB 26:
      PRINT INT(TP):
      VTAB 11:
      HTAB 26:
      PRINT FN P1(FL):
      F = FL
39400 VTAB 14:
      HTAB 29:
      PRINT FN P1(SD):
      VTAB 17:
      HTAB 29:
      PRINT FN P1(GA):
```

```
      VTAB 20:
      HTAB 32:
      WG = VG * DF:
      PRINT FN P1(WG):
      GOTO 41000
40000 N% = 1:
      VTAB 8:
      HTAB 26:
      R = TP:
      GOSUB 1000:
      IF R <  > TP THEN
         TP = R:
         PRINT X$:
         GOSUB 40300
40100 VTAB 11:
      HTAB 26:
      R = FL:
      GOSUB 1000:
      IF R <  > FL THEN
         FL = R:
         F = FL:
         PRINT X$:
         GOSUB 40300
40200 GOTO 40600
40300 IF UO$ = "M" THEN
         F = FL / 2.54:
         GOSUB 8800:
         GA = GA * 6.45:
         SD = SD * 2.54:
         GOTO 40500
40400 GOSUB 8800
40500 VTAB 14:
      HTAB 29:
      PRINT FN P1(SD)X$:
      VTAB 17:
      HTAB 29:
      PRINT FN P1(GA);X$:
      AG = GA * NA / NG:
      RETURN
40600 VTAB 14:
      HTAB 29:
      R = SD:
      GOSUB 1000:
      IF SD <  > R THEN
         SD = R:
         PRINT X$:
         GA = PI * GS * SD * SD / 4:
         AG = GA * NA / NG:
         VTAB 17:
         HTAB 29:
         PRINT FN P1(GA);X$:
```

```
40650 VTAB 17:
      HTAB 29:
      R = GA:
      GOSUB 1000:
      IF GA <  > R THEN
         GA = R:
         PRINT X$:
         AG = GA * NA / NG:
         S = 2 * SQR(GA / GS / PI):
         VTAB 14:
         HTAB 29:
         PRINT FN P1(S);X$:

40700 VTAB 20:
      HTAB 32:
      R = WG:
      GOSUB 1000:
      IF R <  > WG THEN
         WG = R:
         VG = R / DF:
         PRINT X$
41000 GOSUB 2800:
      ON R$ <  > "Y" GOTO 12700:
      GOSUB 3150:
      GOTO 40000

                                          +---+
41300                                     !   !
                                          +---+

41400 CALL 768:
      POP :
      POP :
      GOTO 38700

                              +-------------------------+
41700                         !  *** COST ANALYSIS ***  !
                              +-------------------------+

41800 HOME :
      HTAB 11:
      INVERSE :
      PRINT " COST ANALYSIS ":
      HTAB 11:
      PRINT SPC( 15)"":
      NORMAL :
      I = FRE(0):
      :
      VTAB 5:
      PRINT "  1. ENTER/CHANGE COST DATA":
      VTAB 7:
      PRINT "  2. SHOW COSTS FOR CURRENT RISER"
41900 VTAB 9:
      PRINT "  3. SHOW CUMULATIVE COST ANALYSIS":
      VTAB 11:
      PRINT "  4. ";:
```

```
      INVERSE :
      PRINT "PRINT";:
      NORMAL :
      PRINT " COSTS FOR CURRENT RISER"
42000 VTAB 13:
      PRINT "  5. ";:
      INVERSE :
      PRINT "PRINT";:
      NORMAL :
      PRINT " CUMULATIVE COST ANALYSIS":
      VTAB 15:
      PRINT "  6. RETURN TO MAIN MENU":
      VTAB 18:
      L% = 6:
      GOSUB 3200:
      ON R% GOTO 42100,43700,44000,43700,44000,12700
42100 VTAB 21:
      HTAB 1:
      CALL  - 958:
      PRINT "GET COST INFO FROM DISK?  ";:
      GOSUB 2900:
      ON R$ <  > "Y" GOTO 42310:
      D% = 3:
      ONERR GOTO 48940
42300 VTAB 21:
      GOSUB 9000:
      GOSUB 9500:
      GOSUB 9200:
      INPUT R$,CM,CR,CT,CI,CC,CH,CP:
      GOSUB 9400:
      IF R$ <  > U0$ THEN
         GOSUB 6230
42310 VTAB 5:
      HTAB 1:
      CALL  - 958:
      INVERSE :
      PRINT "COST OF MOLTEN METAL   ($/"U2$"):   ":
      VTAB 7:
      PRINT "CREDIT FOR SCRAP METAL ($/"U2$"):   ":
      VTAB 11:
      PRINT "COST OF HOT TOPPING    ($/"U2$"):   "
42320 VTAB 13:
      PRINT "COST OF TOP INSULATION ($/"U2$"):   ":
      VTAB 17:
      PRINT "RISER/GATE REMOVAL     ($/"U3$"):":
      VTAB 19:
      PRINT "REMOVAL OF CHILLS      ($/"U3$"):":
      VTAB 21:
      PRINT "GRINDING OFF PADS      ($/"U4$"):":
      NORMAL
42400 ON CM = 0 AND CC = 0 GOTO 42500:
      VTAB 5:
```

```
      HTAB 35:
      PRINT FN P3(CM):
      VTAB 7:
      HTAB 35:
      PRINT FN P3(CR):
      VTAB 11:
      HTAB 35:
      PRINT FN P3(CT)
42450 VTAB 13:
      HTAB 35:
      PRINT FN P3(CI):
      VTAB 17:
      HTAB 35:
      PRINT FN P3(CC):
      VTAB 19:
      HTAB 35:
      PRINT FN P3(CH):
      VTAB 21:
      HTAB 35:
      PRINT FN P3(CP):
      GOTO 43500
42500 N% = 1:
      VTAB 5:
      HTAB 35:
      R = CM:
      GOSUB 1000:
      IF R <  > CM THEN
         CM = R:
         PRINT X$
42600 VTAB 7:
      HTAB 35:
      R = CR:
      GOSUB 1000:
      IF R <  > CR THEN
         CR = R:
         PRINT X$
42700 VTAB 11:
      HTAB 35:
      R = CT:
      GOSUB 1000:
      IF R <  > CT THEN
         CT = R:
         PRINT X$
42750 VTAB 13:
      HTAB 35:
      R = CI:
      GOSUB 1000:
      IF R <  > CI THEN
         CI = R:
         PRINT X$
42800 VTAB 17:
      HTAB 35:
```

```
      R = CC:
      GOSUB 1000:
      IF R < > CC THEN
         CC = R:
         PRINT X$
42900 VTAB 19:
      HTAB 35:
      R = CH:
      GOSUB 1000:
      IF R < > CH THEN
         CH = R:
         PRINT X$
43000 VTAB 21:
      HTAB 35:
      R = CP:
      GOSUB 1000:
      IF R < > CP THEN
         CP = R:
         PRINT X$
43500 GOSUB 2800:
      ON R$ < > "Y" GOTO 41800:
      GOSUB 3150:
      GOTO 42500
43700 IF NOT RD THEN
         PRINT :
         CALL 778:
         PRINT "  CANNOT DO COST ANALYSIS UNTIL AFTER":
         HTAB 8:
         FLASH :
         PRINT " RISER SIZE/NECK ":
         NORMAL :
         PRINT "    OPTION HAS BEEN COMPLETED.":
         CALL 778:
         GOSUB 4000:
         GOTO 41800
43800 A$ = "SECTION  ":
      W = NL * NS:
      A = (VC + VR + W) * DF:
      B = NS:
      C = AC:
      D = TW * (RT = 1 OR RT = 5):
      E = DI * TI * PI * RD * RD / 4 * (RT = 2):
      F = E * CI:
      G = LS:
      H = CS:
      S = (VR + W - (SH + NW) * VC / 100) * DF
43900 IF R% = 2 THEN
         GOSUB 44600:
         GOTO 41800
43950 GOSUB 10100:
      F$ = "SECTION NO. " + R$:
      Q$ = "RISER CUTOFF.....  ":
```

```
      GOSUB 46010:
      GOTO 41800
44000 IF NOT VN THEN
         PRINT :
         CALL 778:
         PRINT "  CANNOT DO CUMULATIVE ANALYSIS UNTIL":
         HTAB 9:
         FLASH :
         PRINT " GATING SYSTEM ":
         NORMAL :
         PRINT "    OPTION HAS BEEN COMPLETED.":
         CALL 778:
         GOSUB 4000:
         GOTO 41800
44100 A$ = "CASTING  ":
      A = (VN + RV + NV + VG) * DF:
      B = AN + AG:
      C = NC:
      D = WT:
      E = IW:
      F = IC:
      G = SL:
      H = SP:
      S = (RV + NV + VG - (SH + MW) * VN / 100) * DF:
      IF Rx = 3 THEN
         GOSUB 44600:
         GOTO 41800
44150 F$ = "ENTIRE CASTING":
      Q$ = "RISER/GATE CUTOFF...  ":
      GOSUB 46010:
      GOTO 41800
                                  +--------+
44300                             ! SUBS   !
                                  +--------+
44600 HOME :
      INVERSE :
      PRINT "COST ANALYSIS":
      PRINT "--> "A$:
      NORMAL :
      VTAB 1:
      HTAB 16:
      PRINT "BY: ";LEFT$(UN$,21):
      HTAB 15:
      PRINT "FOR: ";LEFT$(CN$,21):
      VTAB 4:
      PRINT "TYPE: ";:
      INVERSE :
      PRINT M$(RT);:
      IF NL THEN
         PRINT "/NECK"
44700 NORMAL :
      PRINT :
```

```
      VTAB 5:
      PRINT "MOLDING MATERIAL:";:
      INVERSE :
      PRINT MM$:
      NORMAL :
      L% = 7:
      D% = 2
44800 VTAB 8:
      PRINT "MOLTEN METAL:";:
      R$ = STR$(INT(A)) + S$ + U2$ + "    ":
      GOSUB 46100:
      A = A * CM:
      R = A:
      GOSUB 4300
44900 HTAB 1:
      VTAB 10:
      PRINT "R/G CUTOFF:";:
      R$ = STR$(INT(B)) + S$ + U3$:
      GOSUB 46100:
      B = B * CC:
      R = B:
      GOSUB 4300
45000 HTAB 1:
      VTAB 12:
      PRINT "CHILL REMOVAL:";:
      ON C = 0 GOTO 45200:
      R$ = STR$(INT(C)) + S$ + U3$:
      GOSUB 46100:
      C = C * CH:
      R = C:
      GOSUB 4300
45200 HTAB 1:
      VTAB 14:
      PRINT "HOT TOPPING:";:
      ON D = 0 GOTO 45400:
      R$ = STR$(FN P2(D)) + S$ + U2$ + "    ":
      GOSUB 46100:
      D = D * CT:
      R = D:
      GOSUB 4300
45400 HTAB 1:
      VTAB 16:
      PRINT "TOP INSULATION:";:
      ON E = 0 GOTO 45600:
      R$ = STR$(FN P2(E)) + S$ + U2$:
      GOSUB 46100:
      R = F:
      GOSUB 4300
45600 HTAB 1:
      VTAB 18:
      PRINT "RISER SLEEVE:";:
      ON G = 0 GOTO 45800:
```

```
      R$ = STR$(INT(G)) + S$ + U1$ + "    ":
      GOSUB 46100:
      R = H:
      GOSUB 4300
45800 HTAB 1:
      VTAB 20:
      PRINT "SCRAP CREDIT:";:
      R$ = STR$(INT(S)) + S$ + U2$ + "    ":
      GOSUB 46100:
      S =  - S * CR:
      R = S:
      GOSUB 4300:
      VTAB 21:
      HTAB 33:
      PRINT "========"
45900 VTAB 22:
      INVERSE :
      PRINT DT$;:
      NORMAL :
      HTAB 27:
      PRINT "NET:  $";:
      R = A + B + C + D + F + H + S:
      GOSUB 4300
46000 GOSUB 4000:
      RETURN

                                          +---+
46005                                     !   !
                                          +---+

46010 PRINT D$"PR#"P%:
      L% = 8:
      PRINT P$(0)P$(2):
      PRINT :
      PRINT :
      PRINT :
      HTAB 22:
      PRINT "COST ANALYSIS FOR ";F$:
      HTAB 22:
      PRINT "==============================":
      PRINT :
      PRINT
46012 PRINT "  BY:  "LEFT$(UN$,30)TAB( 44)"FOR:  "LEFT$(CN$,30):
      PRINT "DATE:  ";DT$;TAB( 50);LEFT$(CA$,30):
      PRINT SPC( 49);LEFT$(CC$,30):
      PRINT "   PURCHASE ORDER #:  "PO$:
      PRINT "CASTING DESCRIPTION:  "LEFT$(CD$,56)
46013 IF LEN(CD$) > 56 THEN
         PRINT TAB( 23)MID$(CD$,57,56)
46014 PRINT :
      PRINT "USING LOW ALLOY OR CARBON STEEL AT A POURING TEMPERATURE OF  "PT;S$
      U5$:
      PRINT :
      PRINT "   MOLDING MATERIAL:  ";MM$:
```

```
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT
46016 ON R% <  > 4 GOTO 46020:
      PRINT "   RISER TYPE: "M$(RT);:
      IF NL THEN
         PRINT "/NECK";
46018 PRINT :
      PRINT :
      PRINT
46020 PRINT "MOLTEN METAL.........";:
      L = 8:
      R = A:
      GOSUB 4200:
      PRINT "   "U2$TAB( 41)"$";:
      A = A * CM:
      R = A:
      D% = 2:
      GOSUB 4300:
      PRINT
46030 PRINT :
      PRINT Q$;:
      R = B:
      D% = 1:
      GOSUB 4300:
      PRINT S$U3$TAB( 41)"$";:
      B = B * CC:
      R = B:
      D% = 2:
      GOSUB 4300:
      IF A$ = "CASTING  " THEN
         PRINT SPC( 5)"NUMBER OF RISERS: ";MM;
46033 PRINT :
      PRINT :
      PRINT "CHILL REMOVAL.......  ";:
      ON C = 0 GOTO 46040:
      R = C:
      D% = 1:
      GOSUB 4300:
      PRINT S$U3$TAB( 41)"$";:
      C = C * CH:
      R = C:
      D% = 2:
      GOSUB 4300
46040 PRINT :
      PRINT :
      PRINT "HOT TOPPING.........  ";:
      ON D = 0 GOTO 46050:
      R = D:
      D% = 2:
```

```
      GOSUB 4300:
      PRINT S$U2$TAB( 41)"$";:
      D = D * CT:
      R = D:
      GOSUB 4300:
      PRINT SPC( 5)"DENSITY:  "FN P3(TD * (1 + 999 * (U0$ = "M")))S$U6$;
46050 PRINT :
      PRINT :
      PRINT "TOP INSULATION.....  ";:
      ON E = 0 GOTO 46060:
      R = E:
      D% = 2:
      GOSUB 4300:
      PRINT S$U2$TAB( 41)"$";:
      R = F:
      GOSUB 4300:
      PRINT SPC( 5)"DENSITY:  "FN P3(DI * (1 + 999 * (U0$ = "M")))S$U6$;
46060 PRINT :
      PRINT :
      PRINT "RISER SLEEVES.....  ";:
      ON G = 0 GOTO 46070:
      R = G:
      D% = 1:
      GOSUB 4300:
      PRINT S$U1$TAB( 41)"$";:
      R = H:
      D% = 2:
      GOSUB 4300:
      IF A$ = "CASTING  " THEN
         PRINT SPC( 5)"NUMBER OF SLEEVES:  "SS;
46070 PRINT :
      PRINT :
      PRINT "SCRAP CREDIT.....";:
      R = S:
      GOSUB 4200:
      PRINT "   "U2$TAB( 41)"$";:
      S =  - S * CR:
      R = S:
      D% = 2:
      GOSUB 4300:
      PRINT :
      PRINT SPC( 41)"========"
46071 HTAB 20:
      PRINT "NET COSTS....."TAB( 41)"$";:
      R = A + B + C + D + F + H + S:
      GOSUB 4300:
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT
```

```
46075 ON A$ <  > "SECTION  " GOTO 46080:
      PRINT "WEIGHT OF SECTION:   ";:
      R = VC * DF:
      GOSUB 4200:
      PRINT S$U2$:
      PRINT "WEIGHT OF RISER/NECK:";:
      R = (VR + W) * DF:
      GOSUB 4200:
      PRINT S$U2$:
      PRINT
46076 PRINT "SECTION YIELD:   "FN P1(100 * VC / (VC + VR + W))" %":
      PRINT D$"PR#0":
      RETURN
46080 PRINT SPC( 43)"GATING SYSTEM:":
      PRINT :
      PRINT "WEIGHT OF CASTING:       ";:
      R = VN * DF:
      GOSUB 4200:
      PRINT S$U2$TAB( 44)"GATE/SPRUE AREA RATIO: "GS
46085 PRINT "WEIGHT OF RISERS/NECKS:  ";:
      R = (RV + NV) * DF:
      GOSUB 4200:
      PRINT S$U2$TAB( 53)"SPRUE HEIGHT: "FN P1(HS)S$U1$:
      PRINT "WEIGHT OF GATING SYSTEM: ";:
      R = VG * DF:
      GOSUB 4200
46090 PRINT S$U2$TAB( 47)"PATTERN HT IN COPE: "FN P1(HC)S$U1$:
      PRINT SPC( 43)"PATTERN DEPTH IN DRAG: "FN P1(HD)S$U1$:
      PRINT "NET YIELD: "FN P1(100 * VN / (VN + RV + NV + VG))" %"TAB( 50)"NUMBE
      R OF GATES: "NG
46095 PRINT SPC( 47)"FLUIDITY OF STEEL: "FN P1(FL)S$U1$:
      PRINT SPC( 52)"POURING TIME: "FN P1(TP)" SECONDS":
      PRINT D$"PR#0":
      RETURN
46100 HTAB 17:
      INVERSE :
      PRINT RIGHT$(X$ + R$,15);:
      NORMAL :
      PRINT " $";:
      RETURN
                    +-------------------------------------+
46500               !  *** QUIT/STORE FILES ON DISK ***  !
                    +-------------------------------------+
46600 HOME :
      HTAB 7:
      INVERSE :
      PRINT " QUIT/STORE FILES ON DISK ":
      HTAB 7:
      PRINT SPC( 26)"":
      NORMAL :
      I = FRE(0)
46650 VTAB 5:
```

```
      PRINT "   1. SAVE CUSTOMER/CASTING INFO":
      VTAB 7:
      PRINT "   2. SAVE COST INFO":
      VTAB 9:
      PRINT "   3. SAVE SECTION/RISER DATA":
      VTAB 11:
      PRINT "   4. CREATE/EDIT RISER SLEEVE FILE"
46700 VTAB 13:
      PRINT "   5. SHOW CATALOG OF DISK":
      VTAB 15:
      PRINT "   6. RETURN TO MAIN MENU":
      VTAB 17:
      PRINT "   7. QUIT PROGRAM":
      VTAB 20:
      L% = 7:
      GOSUB 3200:
      ON R% GOTO 46800,47400,47700,48600,48210,12700,48890
46800 A$ = "STORE":
      GOSUB 9800:
      ONERR GOTO 48810
46900 VTAB 13:
      F$ = "INFO/" + LEFT$(PO$,20):
      GOSUB 9300
47000 M$ = CHR$(13):
      PRINT UO$M$CA$M$CC$M$CD$M$CN$M$DT$M$MM$M$PO$M$UN$M$;
47100 PRINT AG","AN","DF","DI","FF","FL","GA","GS","HC","HD","HS","IC","IW","MM"
      ,"MP","MW","NA","NC","NG","NV","PT","RV","SH","SL","SN","SP","SS","TD","TP
      ","VG","VN","WT:
      GOSUB 9400
47200 VTAB 3:
      CALL  - 958:
      POKE 216,0:
      VTAB 8:
      PRINT "   THE CUSTOMER/CASTING INFO FILE:":
      VTAB 10:
      HTAB (37 - LEN(F$)) / 2:
      INVERSE :
      PRINT F$:
      NORMAL :
      VTAB 12:
      HTAB 8:
      PRINT "HAS BEEN SAVED TO DISK.":
      GOSUB 4000:
      ONERR GOTO 48880
47300 GOTO 46600
                                        +--+
47350                                   !  !
                                        +--+
47400 VTAB 2:
      CALL  - 958:
      HTAB 7:
      INVERSE :
```

```
      PRINT "    COST INFO    ":
      NORMAL :
      IF NOT CM THEN
         VTAB 10:
         HTAB 7:
         CALL 778:
         PRINT "NO COST DATA TO BE STORED!":
         CALL 778:
         GOSUB 4000:
         GOTO 46600
47450 ONERR GOTO 48820
47500 VTAB 13:
      GOSUB 9000:
      GOSUB 9300:
      PRINT U0$","CM","CR","CT","CI","CC","CH","CP:
      GOSUB 9400:
      ONERR GOTO 48880
47600 GOTO 46600
                                          +--+
47650                                     !  !
                                          +--+
47700 GOSUB 47750:
      GOTO 46600
47750 A$ = "STORE":
      GOSUB 9800:
      ONERR GOTO 48830
47800 HOME :
      HTAB 7:
      INVERSE :
      PRINT " STORE SECTION/RISER DATA ":
      HTAB 7:
      PRINT SPC( 26)"":
      NORMAL :
      I = FRE(0):
      VTAB 8:
      GOSUB 10100:
      GOSUB 9300
47900 PRINT U0$","AC","CI","CN","CS","LS","NL","NS","NR","RD","RH","RT","SA","SC
      ","SR","TI","TW","VC","VR:
      FOR I = 0 TO 9:
         PRINT AC(I)","CN(I)","SC(I)","VC(I):
      NEXT :
      FOR I = 0 TO 9:
         FOR J = 0 TO 9:
            PRINT AJ(I,J):
         NEXT :
      NEXT
48000 GOSUB 9400:
      VTAB 10:
      HTAB 6:
      PRINT "THE SECTION/RISER DATA FILE:":
      VTAB 12:
```

```
      HTAB (37 - LEN(F$)) / 2:
      INVERSE :
      PRINT F$:
      NORMAL :
      VTAB 14:
      HTAB 3:
      PRINT "HAS BEEN SAVED TO DISK.":
      GOSUB 4000:
      ONERR GOTO 48880
48100 VTAB 3:
      CALL  - 958:
      VTAB 10:
      PRINT "DO YOU WANT TO ZERO THE SECTION":
      PRINT :
      PRINT "VARIABLES AND START A NEW SECTION?":
      PRINT :
      HTAB 18:
      GOSUB 2900:
      IF R$ <  > "Y" THEN
         RETURN
48200 AC = 0:
      AG = 0:
      AN = 0:
      CI = 0:
      CN = 0:
      CS = 0:
      IC = 0:
      IW = 0:
      LS = 0:
      MC = 0:
      MN = 0:
      N = 1:
      NC = 0:
      NL = 0:
      NS = 0:
      NN = 0:
      NR = 1:
      NV = 0:
      RD = 0:
      RH = 0:
      RN = 10:
      RT = 0:
      RV = 0:
      SA = 0:
      SC = 0:
      SL = 0:
      SN = 0:
      SP = 0:
      SR = 0:
      SS = 0
48201 TI = 0:
      TP = 0:
```

```
      TW = 0:
      VC = 0:
      VG = 0:
      VN = 0:
      VR = 0:
      WT = 0:
      FOR I = 0 TO 9:
         AC(I) = 0:
         CN(I) = 0:
         SC(I) = 0:
         VC(I) = 0:
         FOR J = 0 TO 9:
            AJ(I,J) = 0:
         NEXT :
      NEXT :
      RETURN
                                          +---+
48205                                     !   !
                                          +---+
48210 PRINT D$"CATALOG":
      GET R$:
      GOTO 46600
                                +------------------------+
48500                           !  RUN ANOTHER PROGRAM   !
                                +------------------------+
48600 GOSUB 48710:
      PRINT D$"RUN CREATE/EDIT SLEEVES,D1"
48610 GOSUB 48710:
      PRINT D$"RUN INSTRUCTIONS,D1"
48620 GOSUB 48710:
      POKE 104,64:
      POKE 16384,0:
      PRINT D$"RUN CASTING SHAPE/SIZE,D1"
48650 VTAB 21:
      GOSUB 48720:
      POKE 104,64:
      POKE 16384,0:
      PRINT D$"RUN RISER SIZE/NECK,D1"
                  +-----------------------------------------+
48700             !  WRITE SCRATCH FILES TO CHAIN VARIABLES  !
                  +-----------------------------------------+
48710 HOME :
      VTAB 10
48720 HTAB 9:
      INVERSE :
      PRINT " PLEASE WAIT WHILE ":
      HTAB 9:
      PRINT " PROGRAM IS LOADED ":
      NORMAL :
      N$ = CHR$(13)
48730 PRINT D$"OPEN SCRATCH1,V222":
      PRINT D$"WRITE SCRATCH1":
```

```
      PRINT CA$M$CC$M$CD$M$CN$M$DT$M$PO$M$UN$M$MM$M$ASC(P$(0))M$;:
      FOR I = 1 TO 8:
         PRINT M$(I)M$ASC(P$(I))M$;:
      NEXT
48740 PRINT CI","CS","DD","DI","FF","MP","MW","NL","NS","P%","PT","RD","RH","RT"
      ,"SA","SH","TD","TI","TW","VR","XM
48750 PRINT CHR$(4)"OPEN SCRATCH2,V222":
      PRINT D$"WRITE SCRATCH2":
      PRINT UO$","U1$","U2$","U3$","U4$","U5$","U6$","AC","AN","CN","DF","IC","I
      W","LS","MM","N","NC","NN","NR","NV","RN","RV","SC","SL","SN","SP","SR","S
      S","VC","VN","WT
48760 FOR I = 0 TO 9:
         PRINT AC(I)","CN(I)","SC(I)","VC(I):
      NEXT :
      FOR I = 0 TO 9:
         FOR J = 0 TO 9:
            PRINT AJ(I,J):
         NEXT :
      NEXT
48770 PRINT CHR$(4)"OPEN SCRATCH3,V222":
      PRINT D$"WRITE SCRATCH3":
      PRINT AG","CC","CH","CM","CP","CR","CT","FL","GA","GS","HC","HD","HS","NA"
      ,"NG","TP","VG","WG:
      PRINT CHR$(4)"CLOSE"
48780 PRINT D$"BLOAD HGR TEXT WRITER,V222,A5888":
      RETURN
                              +-------------------------+
48800                         !  ERROR HANDLER & EXIT   !
                              +-------------------------+
48810 VTAB 15:
      R% = 1:
      GOTO 48840
48820 VTAB 15:
      R% = 2:
      GOTO 48840
48830 VTAB 15:
      R% = 3
48840 R = PEEK(222):
      CALL 778:
      IF R = 8 THEN
         INVERSE :
         PRINT "I/O ERROR.";:
         NORMAL :
         PRINT " CHECK DISK DRIVE..."X$:
         GOSUB 4000:
         GOTO 48920
48850 IF R = 9 THEN
         INVERSE :
         PRINT "DISK FULL.";:
         CALL  - 958:
         NORMAL :
         PRINT :
```

```
          PRINT "DELETE SOME FILES OR CHANGE DISKS...":
          GOSUB 4000:
          GOTO 48920
48860 IF R = 10 THEN
          INVERSE :
          PRINT "FILE LOCKED.";:
          NORMAL :
          PRINT " TRY ANOTHER NAME..."X$:
          GOSUB 4000:
          GOTO 48920
48870 IF R = 11 THEN
          INVERSE :
          PRINT "BAD FILE NAME.";:
          NORMAL :
          PRINT " TRY AGAIN..."X$:
          GOSUB 4000:
          GOTO 48920
48880 HOME :
      VTAB 6:
      PRINT "EXIT ON ERROR NUMBER ";PEEK(222):
      VTAB 8:
      PRINT "AT LINE NUMBER ";PEEK(218) + 256 * PEEK(219):
      GOTO 48900
48890 POKE 34,0:
      HOME :
      VTAB 7:
      PRINT "THANK YOU AND GOOD DAY"
48900 VTAB 11:
      PRINT :
      PRINT "TO RESUME WITH THE SAME CASTING, TYPE:":
      HTAB 27:
      INVERSE :
      PRINT " GOTO 10 ":
      NORMAL :
      PRINT :
      PRINT "TO RUN A NEW CASTING, TYPE:"
48910 HTAB 27:
      INVERSE :
      PRINT " RUN HELLO ":
      NORMAL :
      PRINT :
      PRINT D$"VERIFY HELLO,D1":
      END
48920 ON R% GOTO 46900,47500,47800,12700:
      END
                                          +--+
48930                                     !  !
                                          +--+
48940 ON PEEK(222) = 6 GOTO 48970:
      R% = 4:
      ONERR GOTO 48880
48960 GOTO 48840
```

```
48970 HTAB 1:
      CALL  - 958:
      CALL 778:
      PRINT "FILE NOT FOUND.  TRY AGAIN":
      CALL 778:
      IF D% = 4 THEN
         RN = 10
48980 GOSUB 4000:
      ON D% GOTO 13500,12700,42100,19200
                              +-----------------------------+
63998                         !                             !
63998                         ! 3 APR 1984                  !
64000                         ! M.R. VINER                  !
64000                         ! METALLURGICAL ENGINEERING   !
64000                         ! QUEEN'S UNIVERSITY          !
64000                         ! KINGSTON, ONTARIO  K7L 3N6  !
                              +-----------------------------+
```

****

VARIABLE CROSS REFERENCE:

A 7200 7300 7600 7800 8000 8200 8240 8250 8270 15800 16900 16950 17200 17300 21760 22400 22450 23500 38600 43800 44100 44800 45900 46020 46071

A$ 9900 19200 21400 21500 23400 38300 43800 44100 44600 46030 46060 46075 46800 47750

AC 5500 6220 10400 12650 24550 24600 38500 43800 47900 48200 48750

AC(5550 6223 10400 12650 24600 47900 48201 48760

AG 5500 6214 12660 13900 39100 40500 40600 40650 44100 47100 48200 48770

AJ(5550 6223 10500 12660 47900 48201 48760

AN 5500 6214 12650 13900 19500 38500 44100 47100 48200 48750

B 7200 7300 7600 7800 8000 8200 8220 8230 8240 8250 8270 21800 22450 23500 38500 38600 43800 44100 44900 45900 46030 46071

C 7300 7700 7800 20600 20800 22500 43800 44100 45000 45900 46033 46071

CA$ 12635 13800 14600 14700 15400 46012 47000 48730

CC 5500 6230 12660 42300 42400 42450 42800 44900 46030 47500 48770

CC$ 12635 13800 14800 14900 15400 46012 47000 48730

CD$ 12635 13800 14150 14910 14920 15400 46012 46013 47000 48730

CH 5500 6230 12660 42300 42450 42900 45000 46033 47500 48770

CI 5500 6220 6230 10400 12645 38600 42300 42450 42750 43800 47500 47900 48200 48740

CM 5700 6230 12660 21850 42300 42400 42500 44800 46020 47400 47500 48770

CN 10400 12650 24550 24600 47900 48200 48750

CN$ 12635 13800 14150 14400 14500 15400 44600 46012 47000 48730

CN(10400 12650 24600 47900 48201 48760

CP 5300 6230 12660 21650 21850 42300 42450 43000 47500 48770

CR 5700 6230 12660 42300 42400 42600 45800 46070 47500 48770

CS 10400 12645 38600 43800 47900 48200 48740

CT 5700 6230 12660 42300 42400 42700 45200 46040 47500 48770

D 7300 7700 7800 8800 20800 22500 37700 38850 43800 44100 45200 45900 46040 46071

D$ 9200 9300 9500 12610 12630 12650 12660 21900 46010 46076 46095 48210 48600 48610 48620 48650 48730 48750 48770 48780 48910

D% 4300 4310 4320 13550 15800 19200 21750 21760 22400 22500 23200 23400 24600 42100 44700 46020 46030 46033 46040 46050 46060 46070 48970 48980

DD 9300 9500 12645 48740

DF 6100 6212 8700 12650 13900 21850 24600 38850 39100 39200 39400 40700 43800 44100 46075 46080 46085 47100 48750

DI 6100 6212 12645 13900 15800 16950 17300 38600 43800 46050 47100 48740

DT$ 12635 13800 15200 15300 15400 45900 46012 47000 48730

E 8250 20800 43800 44100 45400 46050

F 8000 8600 8650 8800 20800 39200 40100 40300 43800 44100 45400 45900 46050 46071

F$ 4300 4320 9100 9200 9300 9500 10300 13550 13700 38400 43950 44150 46010 46900 47200 48000

FF 7200 7300 7600 7800 8220 8230 12645 13900 18100 18200 18300 18400 22500 47100 48740

FL 5900 6212 8600 8650 12660 13900 38850 39200 40100 40300 46095 47100 48770

G 8000 8250 21800 23600 43800 44100 45600 46060

GA 5500 6214 8800 12660 13900 39000 39100 39400 40300 40500 40600 40650

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**********************************************************************************

      47100 48770
GS     8800 12660 13900 36800 36900 40600 40650 46080 47100 48770
H      8000 23600 43800 44100 45600 45900 46060 46071
HC     5900  6212 12660 13900 36850 37100 37700 46090 47100 48770
HD     5900  6212 12660 13900 36850 37200 37700 46090 47100 48770
HS     5900  6212 12660 13900 36850 37000 37700 46085 47100 48770
I       300  5300  5550  6223  8210  8240 12640 12650 12660 12700 13500 14500
      14700 14900 14920 15100 15300 15320 19900 22100 24300 24550 24600 36600
      37900 38300 38400 38410 38700 41800 46600 47800 47900 48201 48730 48760
IC    12650 13900 19500 38600 44100 47100 48200 48750
IW     5700  6214 12650 13900 19500 38600 44100 47100 48200 48750
J      5550  6223 10500 12660 47900 48201 48760
L      1100  5000  5300  5500  5700  5900  6100  6210  6212  6214  6220  6223
       6230 10400 10500 21200 21850 46020
L%      300  1000  1410  1500  1600  3300  4200  4320 13000 13550 14400 14500
      14600 14700 14800 14900 14910 14920 15000 15100 15200 15300 15310 15320
      15800 16950 18000 18600 21200 21750 21760 21900 23200 23400 24305 24550
      42000 44700 46010 46700
LS     5900  6220 10400 12650 38600 43800 47900 48200 48750
M      7700  7800  8210  8220  8230 21400 22500 23600 23700
MS    47000 48720 48730
MS(   12640 44600 46016 48730
MC     5900 19500 24550 48200
MM    12650 13900 19500 38300 38500 46030 47100 48200 48750
MMS   12640 13800 17800 18100 18200 18300 18400 18700 18800 18900 19000 21900
      44700 46014 47000 48730
MP     5000  6210 12645 13900 15780 16900 17100 47100 48740
MW    12645 13900 18100 18200 18300 18400 18700 18800 18900 19000 43800 44100
      47100 48740
N     12650 48200 48750
N%     1100  1600  9000 13550 14400 17000 20200 21600 24750 36900 40000 42500
NA    12660 13900 36850 37400 37500 39100 40500 40600 40650 47100 48770
NC     5500  6214 12650 13900 19500 38500 44100 47100 48200 48750
NG    12660 13900 36800 36850 37300 37400 39100 40500 40600 40650 46090 47100
      48770
NL     5900  6220 10400 12645 38500 43800 44600 46016 47900 48200 48740
NN    12650 24550 24600 24700 48200 48750
NR    10400 12650 38500 38600 47900 48200 48750
NS     5500  6220 10400 12645 38500 43800 47900 48200 48740
NV     5300  6212 12650 13900 19500 38500 44100 46085 46090 47100 48200 48750
P     12700 21900
PS(   12640 21900 46010 48730
P%    12610 12645 21900 46010 48740
P1(   12610 36850 38850 39200 39400 40500 40600 40650 46076 46085 46090 46095
P2(   12610 20100 39200 45200 45400
P3(   12610 15800 16950 42400 42450 46040 46050
PI     8800 12610 20800 38500 40600 40650 43800
POS    9800 10300 12635 13800 14150 15000 15100 15400 38400 46012 46900 47000
      48730
PT     5000  6210  8600  8650 12645 13900 15780 16900 17000 46014 47100 48740
Q      7200  7600  7700  7800  8200 20700 20800 22500 24550 24600
QS      300  1000  1410  1500  1600  9000  9100 12640 13550 14400 14500 14600
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      14700 14800 14900 14910 14920 15000 15100 15200 15300 15310 15320 21400
      21500 23400 43950 44150 46030
R      1600  4200  4300  8700 10200 10250 12610 15800 16950 17000 17100 17150
      17200 17300 20200 20500 20700 21600 21650 21750 21760 21800 22400 22450
      22500 23200 23500 23600 23700 24600 24750 36900 37000 37100 37200 37300
      37400 37500 40000 40100 40600 40650 40700 42500 42600 42700 42750 42800
      42900 43000 44800 44900 45000 45200 45400 45600 45800 45900 46020 46030
      46033 46040 46050 46060 46070 46071 46075 46080 46085 48840 48850 48860
      48870
R$     250  1100  1410  1500  2900  3300  3400  4300  4310  4320 10100 10200
      10260 10300 10400 10500 13510 13800 13900 15600 16200 16300 16400 16600
      17600 17800 19200 21400 21500 21600 22800 24310 37600 37950 41000 42100
      42300 43500 43950 44800 44900 45000 45200 45400 45600 45800 46100 48100
      48210
R%     3300  4310  4320 13100 18000 18600 21300 24305 42000 43900 44100 46016
      46700 48810 48820 48830 48920 48940
RD     5900  6220 10400 12645 38500 43700 43800 47900 48200 48740
RH     5900  6220 10400 12645 47900 48200 48740
RN    10100 10300 12650 48200 48750 48970
RT    10400 12645 38500 38600 43800 44600 46016 47900 48200 48740
RV     5300  6212 12650 13900 19500 38500 44100 46085 46090 47100 48200 48750
S      8200  8240 21750 40650 43800 44100 45800 45900 46070 46071
S$     1600  9000 12610 15400 15800 16950 20900 21750 21760 21800 21850 23200
      23500 23600 23700 24700 44800 44900 45000 45200 45400 45600 45800 46014
      46030 46033 46040 46050 46060 46075 46080 46085 46090 46095
SA    10400 12645 47900 48200 48740
SC     5500  6220 10400 12650 24550 24600 38500 47900 48200 48750
SC(    5550  6223 10400 12650 24550 24600 47900 48201 48760
SD     8800 39000 39400 40300 40500 40600
SH     6600  8250 12645 13900 15780 17110 17150 20800 43800 44100 47100 48740
SL     5900  6212 12650 13900 19500 38600 44100 47100 48200 48750
SN     5500  6214  8700 12650 13900 19500 38500 39200 47100 48200 48750
SP    12650 13900 19500 38600 44100 47100 48200 48750
SR    10400 12650 24600 24700 24750 47900 48200 48750
SS    12650 13900 19500 38300 38500 46060 47100 48200 48750
T      7200  7600  7700  7800  8200  8240  8250 19900 20100 20200 20600 20700
      20800 20900 21850 22400 22450 22500 23200 23700
TD     6100  6212 12645 13900 15800 16950 17200 46040 47100 48740
TI     5900  6220 10400 12645 38600 43800 47900 48201 48740
TP     8700  8800 12660 13900 39200 40000 46095 47100 48201 48770
TW     5700  6220 10400 12645 38600 43800 47900 48201 48740
U0$    5000  6150  6210  6220  6230  8700 10500 12650 13900 15780 15800 16600
      16900 19900 37700 38850 39000 40300 42300 46040 46050 47000 47500 47900
      48750
U1$    6150 12650 20000 20900 21600 21750 21760 21800 21900 23200 23500 23600
      23700 24550 36700 38800 39200 45600 46060 46085 46090 46095 48750
U2$    6150 12650 24550 38810 39200 42310 42320 44800 45200 45400 45800 46020
      46040 46050 46070 46075 46080 46085 46090 48750
U3$    6150 12650 38810 42320 44900 45000 46030 46033 48750
U4$    6150 12650 21650 21850 42320 48750
U5$    6150 12650 15750 16900 46014 48750
U6$    6150 12650 15760 16950 46040 46050 48750
```

```
  UN$  12640 13800 15310 15320 15400 44600 46012 47000 48730
  V     8250  8800 21850 38850
  VC    5300  6220 10400 12650 24300 24550 24600 24650 38500 43800 46075 46076
       47900 48201 48750
  VC(   5300  6223 10400 12650 24550 24600 24750 47900 48201 48760
  VG    5300  6212  8700 12660 13900 39100 39400 40700 44100 46085 46090 47100
       48201 48770
  VN    5300  6212  8700 12650 13900 19500 38500 38800 38850 39200 44000 44100
       46080 46090 47100 48201 48750
  VR    5300  6220 10400 12645 38500 43800 46075 46076 47900 48201 48740
  W     8210  8250  8700 19900 20100 20500 20600 20700 20800 21850 22400 23200
       38850 43800 46075 46076
  WG    5700 12660 39100 39400 40700 48770
  WT    5700  6214 12650 13900 19500 38600 44100 47100 48201 48750
  X     8200  8210  8220  8230  8240  8250 21800
  X$    4200  4320 12610 16900 16950 17000 17100 17110 17150 17200 17300 20200
       20500 36900 37000 37100 37200 37300 37400 37500 40000 40100 40500 40600
       40650 40700 42500 42600 42700 42750 42800 42900 43000 46100 48840 48860
       48870
  XM    5900 12645 48740
  Y     7300  8200  8240  8250  8270 21600 21760
  Z     5300  5500  5550  5700  5900  6100  6212  6214  6220  6223  6230  8700
       19900 20100 20200 20500 20900 21600 21760 21800 21850 22400 22450 22500
       23200 23500 23600 23700
```

NOTES:

```
 * INDICATES SYMBOL REFERENCED AT ONE LINE NUMBER ONLY.
** INDICATES SYMBOL EQUIVALENT TO PREVIOUSLY DEFINED SYMBOL.
-> INDICATES UNDEFINED SYMBOL.

LINE NUMBER 99999 ==> TOO MANY REFERENCES TO THE VARIABLE;
                      LATER REFERENCES ARE NOT LISTED.
```

```
                          +--------------------------+
 10                       ! ************************ !
 10                       ! * CANMET RISERING  2.1 * !
 10                       ! *                      * !
 10                       ! *  CASTING SHAPE/SIZE  * !
 10                       ! ************************ !
                          +--------------------------+
100 ON PEEK(104) <  > 64 OR PEEK(6380) <  > 96 GOTO 120:
    ONERR GOTO 120
110 PRINT CHR$(4)"VERIFY SCRATCH2,V222":
    POKE 216,0:
    GOTO 1900
120 POKE 216,0:
    HOME :
    VTAB 10:
    PRINT "  CANNOT RUN ";:
    INVERSE :
    PRINT " CASTING SHAPE/SIZE ":
    NORMAL :
    PRINT :
    PRINT "EXCEPT FROM CANMET RISERING PACKAGE."
130 VTAB 16:
    PRINT "   TO DO SO, TYPE ";:
    INVERSE :
    PRINT " RUN HELLO ":
    NORMAL :
    PRINT :
    END

                             +----------------------+
200                          ! *** SUBROUTINES *** !
                             +----------------------+
210 GET R$:
    IF R$ = CHR$(16) THEN
       CALL 800:
       GOTO 210
220 RETURN

                                      +--+
230                                   !  !
                                      +--+

235 VTAB 24:
    HTAB 1:
    CALL  - 958:
    HTAB 5:
    INVERSE :
    PRINT " PRESS SPACE BAR TO CONTINUE...";:
    NORMAL :
    GOSUB 210:
    VTAB 1:
    PRINT :
    RETURN

                             +----------------------+
240                          !  DECIMAL ALIGNMENT   !
```

```
                                    +---------------------+
245 R$ = STR$(INT(R * 10^ D% + .5)):
    F$ = "":
    IF LEFT$(R$,1) = "-" THEN
       R$ = RIGHT$(R$,LEN(R$) - 1):
       F$ = "-"
250 R% = LEN(R$):
    IF R% < D% + 1 THEN
       R$ = "0" + R$:
       GOTO 250
255 PRINT RIGHT$(X$ + F$ + LEFT$(R$,R% - D%) + "." + RIGHT$(R$,D%),L%);:
    RETURN

                                          +---+
310                                       !   !
                                          +---+
320 PRINT "WHICH?  PRESS A NUMBER KEY...  ";
330 GOSUB 210:
    R% = VAL(R$):
    IF R% < 1 OR R% > L% THEN
       CALL 778:
       GOTO 330
340 PRINT R$;:
    RETURN

                                          +---+
370                                       !   !
                                          +---+
380 PRINT "CHANGE ANY DIMENSIONS? ";
390 INVERSE :
    PRINT "Y/N";:
    NORMAL :
    PRINT " ";:
    GOSUB 210:
    IF R$ = "y" THEN
       R$ = "Y"
400 PRINT R$;:
    HTAB 1:
    RETURN

                                          +---+
430                                       !   !
                                          +---+
440 A = 0:
    B = 0:
    C = 0:
    D = 0:
    E = 0:
    F = 0:
    G = 0:
    RETURN

                                          +---+
445                                       !   !
                                          +---+
450 C% = I / 10000:
```

```
      R% = I / 10 - 1000 * C%:
      R = I - 10000 * C% - 10 * R%:
      R$ = CHR$(R + 64):
      IF R = 3 THEN
         R = 29
  460 Q$ = CHR$(127) + CHR$(R) + CHR$(127):
      GOSUB 780:
      RETURN
                              +----------------------------+
  470                         !  GET DIMENSION FOR SHAPE   !
                              +----------------------------+
  480 C% = I / 1000:
      R% = I - 1000 * C%:
      HTAB 6:
      PRINT "LENGTH OF ";:
      INVERSE :
      PRINT R$;:
      NORMAL :
      PRINT " ("U1$")?  ";:
      I = FRE(0)
  510 L% = 1:
      Q$ = ""
  520 GOSUB 210:
      L = ASC(R$):
      ON L = 13 GOTO 600:
      ON L = 8 GOTO 570:
      IF L < 46 OR L = 47 OR L > 57 THEN
         CALL 778:
         GOTO 520
  560 PRINT R$;:
      L% = L% + 1:
      Q$ = Q$ + R$:
      GOTO 520
  570 L% = L% - 1:
      ON L% < 1 GOTO 510:
      PRINT R$" "R$;:
      ON L% = 1 GOTO 510:
      Q$ = LEFT$(Q$,L% - 1):
      GOTO 520
  600 IF L% = 1 AND NOT G THEN
         CALL 778:
         GOTO 520
  605 G = VAL(S$ + Q$) + G * (L% = 1):
      IF C% < 280 THEN
         HTAB 25:
         PRINT G;X$:
         Q$ = STR$(G) + "   ":
         GOSUB 780
  606 RETURN
                                        +---+
  610                                   !   !
                                        +---+
```

```
620 INVERSE :
    CALL 778:
    PRINT "SORRY, MUST BE < "FN P2(R):
    NORMAL :
    RETURN

                                          +---+
645                                       !   !
                                          +---+

650 PRINT "IS THE "RIGHT$(A$,LEN(A$) - 3)" HOLLOW? ";:
    GOSUB 390:
    PRINT :
    ON R$ <  > "Y" GOTO 665:
    PRINT "SHELL THICKNESS ("U1$"): ";:
    C% = 300:
    G = D:
    GOSUB 510:
    D = G
660 PRINT :
    PRINT :
    PRINT "IS THE INNER SURFACE A COOLING SURFACE?":
    HTAB 34:
    GOSUB 390:
    C = (R$ = "Y"):
    PRINT
665 RETURN

                          +-----------------------+
690                       !  MENU FOR EACH SHAPE  !
                          +-----------------------+

700 HOME :
    VTAB 21:
    GOSUB 750:
    PRINT "1. SHOW NEXT SHAPE":
    PRINT "2. USE THIS SHAPE":
    PRINT "3. RETURN TO SHAPE MENU":
    HTAB 27:
    INVERSE :
    PRINT "WHICH? ";:
    NORMAL :
    PRINT "  ";:
    L% = 3:
    GOSUB 330:
    IF R% = 3 THEN
       POP :
       GOTO 2000
730 GOSUB 440:
    RETURN

                                          +---+
740                                       !   !
                                          +---+

750 C% = 146:
    R% = 12:
    IF VC(N) > 0 THEN
```

```
        Q$ = "NET VOL. = " + STR$(FN P2(VC(N))) + "    ":
        GOSUB 780:
        R% = 22:
        Q$ = "NET AREA = " + STR$(FN P2(SC(N))) + "    ":
        GOSUB 780
760 RETURN
                                          +--+
770                                       !  !
                                          +--+
780 POKE 5889,0:
    POKE 5890,C%:
    POKE 5891,R%:
    L = LEN(Q$):
    FOR I = 1 TO L:
       R = ASC(MID$(Q$,I,1)):
       POKE 5893,R:
       CALL 6381:
    NEXT :
    RETURN
                                          +--+
790                                       !  !
                                          +--+
800 C% = 1:
    R% = 140:
    Q$ = "VOLUME (" + U4$ + ") = " + STR$(FN P2(V)):
    GOSUB 780:
    R% = 150:
    Q$ = "SURFACE AREA (" + U3$ + ") = " + STR$(FN P2(S)):
    GOSUB 780
810 HOME :
    VTAB 22:
    INVERSE :
    PRINT "A";:
    NORMAL :
    PRINT "DD TO OR ";:
    INVERSE :
    PRINT "S";:
    NORMAL :
    PRINT "UBTRACT FROM SECTION?  ";
820 GOSUB 210:
    IF R$ <  > "A" AND R$ <  > "a" AND R$ <  > "S" AND R$ <  > "s" THEN
       CALL 778:
       GOTO 820
830 PRINT R$:
    INPUT "HOW MANY OF THIS SIZE/SHAPE? ";Q$:
    I = VAL(Q$):
    IF R$ = "S" THEN
       VC(N) = VC(N) - V * I:
       GOTO 2000
840 SC(N) = SC(N) + S * I:
    VC(N) = VC(N) + V * I
850 PRINT :
```

```
      PRINT "ANY NON-COOLING AREAS? ";:
      GOSUB 390:
      Q = 0:
      IF R$ = "Y" THEN
         A$ = "NON-COOLING AREA":
         Q = 1:
         HOME :
         GOSUB 890
  860 HOME :
      VTAB 22:
      INVERSE :
      PRINT "ANY CHILLED AREAS?";:
      NORMAL :
      PRINT " ";:
      GOSUB 390:
      ON R$ <  > "Y" GOTO 2000
  865 IF Q = 1 THEN
         Q$ = "CHILL CONTACT AREA":
         C% = 10:
         R% = 0:
         GOSUB 780:
         Q$ = "CHILL AREAS" + X$:
         C% = 56:
         R% = 138:
         GOSUB 780:
         Q = 2:
         GOSUB 910:
         GOTO 2000
  870 A$ = "CHILL CONTACT AREA":
      Q = 2:
      GOSUB 890:
      GOTO 2000

                              +----------------------------+
  880                         !  NON-COOLING/CHILL AREAS  !
                              +----------------------------+

  890 HGR :
      Q$ = A$:
      C% = 10:
      R% = 0:
      GOSUB 780:
      Q$ = "=================":
      R% = 10:
      GOSUB 780:
      Q$ = "1. RECTANGULAR":
      C% = 0:
      R% = 30:
      GOSUB 780:
      DRAW 1 AT 110,30:
      Q$ = "2. CIRCULAR":
      R% = 48:
      GOSUB 780:
      DRAW 2 AT 111,48:
```

```
      Q$ = "3. RING SHAPE"
  900 R% = 66:
      GOSUB 780:
      DRAW 3 AT 122,69:
      Q$ = "4. ELLIPTICAL":
      R% = 84:
      GOSUB 780:
      DRAW 4 AT 110,84:
      Q$ = "5. TRIANGULAR":
      R% = 102:
      GOSUB 780:
      DRAW 5 AT 115,102:
      Q$ = "6. COMPLEX":
      R% = 120:
      GOSUB 780
  905 Q$ = "7. QUIT " + A$ + "S":
      R% = 138:
      GOSUB 780
  910 HOME :
      GOSUB 750:
      VTAB 21:
      L% = 7:
      GOSUB 320:
      HOME :
      GOSUB 440:
      C% = 300:
      ON R% GOTO 930,960,981,990,1020,1060,665
  930 VTAB 21:
      INVERSE :
      PRINT "RECTANGLE";:
      NORMAL :
      PRINT "   LENGTH ("U1$"): ";:
      G = A:
      GOSUB 510:
      A = G:
      HTAB 26:
      PRINT A"    ":
      HTAB 14:
      PRINT "WIDTH ("U1$"): ";:
      G = B:
      GOSUB 510:
      B = G:
      HTAB 26:
      PRINT B"    "
  940 VTAB 23:
      GOSUB 380:
      IF R$ = "Y" THEN
         HOME :
         GOTO 930
  950 S = A * B:
      VTAB 23:
      GOTO 1070
```

```
960 VTAB 21:
    INVERSE :
    PRINT "CIRCLE";:
    NORMAL :
    PRINT "   DIAMETER ("U1$"): ";:
    G = A:
    GOSUB 510:
    A = G:
    HTAB 25:
    PRINT A"    "
970 VTAB 23:
    GOSUB 380:
    IF R$ = "Y" THEN
       HOME :
       GOTO 960
980 S = PI * A * A / 4:
    VTAB 23:
    GOTO 1070
981 VTAB 21:
    INVERSE :
    PRINT "RING SHAPE";:
    NORMAL :
    PRINT "   INNER DIAM ("U1$"): ";:
    G = A:
    GOSUB 510:
    A = G:
    HTAB 31:
    PRINT A"    ":
    HTAB 14:
    PRINT "OUTER DIAM ("U1$"): ";:
    G = B
982 GOSUB 510:
    B = G:
    IF A > B THEN
       HTAB 31:
       CALL  - 868:
       CALL 778:
       GOTO 982
983 HTAB 31:
    PRINT B"    ":
    VTAB 23:
    GOSUB 380:
    IF R$ = "Y" THEN
       HOME :
       GOTO 981
984 S = PI * (B * B - A * A) / 4:
    VTAB 23:
    GOTO 1070
990 VTAB 21:
    INVERSE :
    PRINT "ELLIPSE";:
    NORMAL :
```

```
      PRINT "   LONG AXIS ("U1$"): ";:
      G = A:
      GOSUB 510:
      A = G:
      HTAB 27:
      PRINT A"    ":
      HTAB 10:
      PRINT "SHORT AXIS ("U1$"): ";:
      G = B:
      GOSUB 510:
      B = G:
      HTAB 27:
      PRINT B"    "
 1000 VTAB 23:
      GOSUB 380:
      IF R$ = "Y" THEN
         HOME :
         GOTO 990
 1010 S = PI * A * B / 4:
      VTAB 23:
      GOTO 1070
 1020 VTAB 21:
      INVERSE :
      PRINT "TRIANGLE";:
      NORMAL :
      PRINT "    FIRST SIDE ("U1$"): ";:
      G = A:
      GOSUB 510:
      A = G:
      HTAB 30:
      PRINT A"    ":
      HTAB 12:
      PRINT "SECOND SIDE ("U1$"): ";:
      G = B:
      GOSUB 510:
      B = G:
      HTAB 30:
      PRINT B"    "
 1030 HTAB 13:
      PRINT "THIRD SIDE ("U1$"): ";:
      G = C:
      GOSUB 510:
      C = G:
      HTAB 30:
      PRINT C"    "
 1040 VTAB 24:
      GOSUB 380:
      IF R$ = "Y" THEN
         HOME :
         GOTO 1020
 1045 S = (A + B + C) / 2:
      IF A > S OR B > S OR C > S THEN
```

```
        HOME :
        VTAB 21:
        CALL 778:
        PRINT "  THE DIMENSIONS YOU ENTERED ARE          NOT CONSISTENT WITH A
        TRIANGLE!":
        GOSUB 235:
        HOME :
        GOTO 910
1050 S = SQR(S * (S - A) * (S - B) * (S - C)):
     VTAB 24:
     GOTO 1070
1060 VTAB 21:
     INVERSE :
     PRINT "COMPLEX SHAPE:":
     NORMAL :
     HTAB 5:
     PRINT "ESTIMATED AREA ("U3$"): ";:
     G = 0:
     GOSUB 510:
     S = G:
     HTAB 29:
     PRINT S"    "
1070 HOME :
     VTAB 21:
     ON Q = 2 GOTO 1080:
     PRINT "IS THIS AREA CONNECTED TO ANOTHER":
     PRINT "SUB-SECTION FED BY THE SAME RISER? ";:
     GOSUB 390:
     J = 10:
     ON R$ <  > "Y" GOTO 1080:
     PRINT :
     PRINT :
     PRINT "WHICH SUB-SECTION? ";
1072 GET R$:
     J = ASC(R$):
     ON J < 48 OR J > 57 GOTO 1075:
     J = VAL(R$):
     IF J <  > N GOTO 1080
1075 CALL 778:
     HTAB 20:
     CALL  - 958:
     GOTO 1072
1080 HOME :
     VTAB 22:
     PRINT "HOW MANY AREAS OF THIS SIZE/SHAPE? ";:
     G = 0:
     GOSUB 510:
     I = G:
     SC(N) = SC(N) - I * S * (Q = 1) + I * S * (Q = 2):
     AJ(N,J) = AJ(N,J) + I * S * (Q = 1) * (J < 10)
1090 ON Q = 1 GOTO 910:
     AC(N) = AC(N) + I * S:
```

```
      CN(I) = CN(I) + I:
      GOTO 910
                              +-------------------------+
 1899                         ! **** MAIN PROGRAM **** !
                              +-------------------------+
 1900 POKE 51,128:
      IF VC OR V THEN 2000
 1910 DIM X%(1000),Y%(1000):
      D$ = CHR$(13) + CHR$(4):
      S$ = " ":
      X$ = "           ":
      PI = 3.14159:
      ROT= 0:
      SCALE= 1:
      HCOLOR= 3:
      DEF FN P2(R) = INT(R * 100 + .5) / 100
 1920 HOME :
      VTAB 10:
      HTAB 9:
      PRINT "PROGRAM IS LOADED"
 1930 PRINT D$"OPEN SCRATCH2,V222":
      PRINT D$"READ SCRATCH2":
      INPUT U0$,U1$,U2$,U3$,U4$,U5$,U6$,AC,AN,CN,DF,IC,IW,LS,MM,N,NC,NN,NR,NV,RN
      ,RV,SC,SL,SN,SP,SR,SS,VC,VN,WT
 1940 FOR I = 0 TO 9:
         INPUT AC(I),CN(I),SC(I),VC(I):
      NEXT :
      FOR I = 0 TO 9:
         FOR J = 0 TO 9:
            INPUT AJ(I,J):
         NEXT :
      NEXT :
      PRINT D$"CLOSE"
 2000 TEXT :
      HOME :
      HTAB 6:
      INVERSE :
      PRINT "  CASTING SHAPE/SIZE: ":
      HTAB 6:
      PRINT "       SHAPE MENU       ":
      NORMAL :
      VTAB 5:
      POKE 34,1:
      I = FRE(0)
 2100 PRINT "  1. SET SUB-SECTION NUMBER":
      PRINT :
      PRINT "  2. RECTANGULAR SHAPES/PYRAMID":
      PRINT :
      PRINT "  3. CYLINDER/TORUS/SPHERE":
      PRINT :
      PRINT "  4. COMPLEX CROSS-SECTION":
      PRINT :
```

```
      PRINT "  5. CALCULATE RISER SIZE/NECK"
 2200 PRINT :
      PRINT "  6. RETURN TO MAIN MENU":
      PRINT :
      PRINT :
      L% = 6:
      GOSUB 320:
      ON R% GOTO 2400,3350,7850,12400,16000,16000
 2400 HOME :
      VTAB 4:
      CALL 778:
      PRINT "SUB-SECTIONS FED BY THE SAME RISER      SHOULD BE SEPARATELY IDENTI
      FIED WHEN    THEY HAVE SIGNIFICANTLY DIFFERENT       MODULUS VALUES."
 2600 VTAB 11:
      PRINT "CURRENT SUB-SECTION # ";:
      INVERSE :
      PRINT S$N;S$:
      NORMAL :
      VTAB 14:
      PRINT "START A NEW SUB-SECTION? ";:
      GOSUB 390:
      IF R$ <  > "Y" GOTO 2000
 2700 VTAB 17:
      INVERSE :
      PRINT "NEW SUB-SECTION NUMBER (0-9): ";:
      NORMAL :
      PRINT " ";
 2900 GOSUB 210:
      R = ASC(R$):
      IF R < 48 OR R > 57 THEN
         CALL 778:
         GOTO 2900
 3000 N = VAL(R$):
      PRINT N:
      ON VC(N) = 0 GOTO 3200:
      VTAB 17:
      PRINT "ERASE CURRENT VALUES FOR # ";:
      INVERSE :
      PRINT S$;N;S$;:
      NORMAL :
      PRINT "? ";:
      GOSUB 390:
      IF R$ <  > "Y" GOTO 2000
 3200 AC(N) = 0:
      CN(N) = 0:
      SC(N) = 0:
      VC(N) = 0:
      FOR J = 0 TO 9:
         AJ(N,J) = 0:
      NEXT :
      AC = 0:
      AN = 0:
```

```
      CN = 0:
      IC = 0:
      IW = 0:
      LS = 0:
      MC = 0:
      MM = 0:
      NC = 0:
      NR = 0:
      NV = 0:
      RV = 0:
      SC = 0:
      SL = 0:
      SN = 0:
      SP = 0:
      SR = 0:
      SS = 0:
      VC = 0:
      VN = 0:
      WT = 0:
      GOTO 2000
                              +-------------------------------+
3300                          ! **** RECTANGULAR SHAPES **** !
                              +-------------------------------+
3350 PRINT D$"BLOAD RECTANGULAR SHAPES,A2048,V222"
3400 HGR :
      Q$ = "A) RIGHT-ANGLE PRISM":
      C% = 0:
      R% = 0:
      GOSUB 780:
      DRAW 6 AT 170,110:
      GOSUB 700:
      IF R% = 1 GOTO 4200
3700 I = 1380351:
      G = A:
      GOSUB 450:
      HOME :
      VTAB 21:
      I = 166035:
      GOSUB 480:
      A = G
3800 I = 1950902:
      G = B:
      GOSUB 450:
      I = 223090:
      GOSUB 480:
      B = G
3900 I = 2160553:
      G = C:
      GOSUB 450:
      I = 244055:
      GOSUB 480:
      C = G
```

```
4100 GOSUB 380:
     ON R$ = "Y" GOTO 3700:
     S = 2 * (A * B + B * C + A * C):
     V = A * B * C:
     GOTO 800
4200 HGR :
     Q$ = "B) TAPERED PRISM":
     C% = 0:
     R% = 0:
     GOSUB 780:
     DRAW 7 AT 180,110:
     GOSUB 700:
     IF R% = 1 GOTO 5100
4500 I = 0640501:
     G = A:
     GOSUB 450:
     I = 064036:
     HOME :
     VTAB 21:
     GOSUB 480:
     A = G
4600 I = 1101152:
     G = B:
     GOSUB 450:
     I = 138115:
     GOSUB 480:
     B = G
4700 I = 0390973:
     G = C:
     GOSUB 450:
     I = 039111:
     GOSUB 480:
     C = G
4800 I = 2150664:
     G = D:
     GOSUB 450:
     I = 243066:
     GOSUB 480:
     D = G
5000 GOSUB 380:
     ON R$ = "Y" GOTO 4500:
     S = (A + B) * (C + D) + A * (B + SQR(B^ 2 + (ABS(C - D))^ 2)):
     V = A * B * (C + D) / 2:
     GOTO 800
5100 HGR :
     Q$ = "C) TRAPEZOID":
     C% = 0:
     R% = 0:
     GOSUB 780:
     DRAW 8 AT 175,110:
     GOSUB 700:
     IF R% = 1 GOTO 6000
```

```
5400 I = 1120681:
     G = A:
     GOSUB 450:
     I = 140068:
     HOME :
     VTAB 21:
     GOSUB 480:
     A = G
5500 I = 1200432:
     G = B:
     GOSUB 450:
     I = 148043:
     GOSUB 480:
     B = G
5600 I = 1151153:
     G = C:
     GOSUB 450:
     I = 143115:
     GOSUB 480:
     C = G
5700 I = 2100654:
     G = D:
     GOSUB 450:
     I = 238065:
     GOSUB 480:
     D = G
5900 GOSUB 380:
     ON R$ = "Y" GOTO 5400:
     S = (A + D) * (B + C) + 2 * D * SQR(A^ 2 + (ABS(B - C))^ 2 / 4):
     V = A * D * (B + C) / 2:
     GOTO 800
6000 HGR :
     Q$ = "D) PYRAMID":
     C% = 0:
     R% = 0:
     GOSUB 780:
     DRAW 9 AT 210,115:
     GOSUB 700:
     IF R% = 1 GOTO 6800
6300 I = 1201201:
     G = A:
     GOSUB 450:
     I = 148120:
     HOME :
     VTAB 21:
     GOSUB 480:
     A = G
6400 I = 2150952:
     G = B:
     GOSUB 450:
     I = 243095:
     GOSUB 480:
```

```
      B = G
 6500 I = 1470803:
      G = C:
      GOSUB 450:
      I = 147090:
      GOSUB 480:
      C = G
 6700 GOSUB 380:
      ON R$ = "Y" GOTO 6300:
      S = A * B + A * SQR(C^ 2 + B^ 2 / 4) + B * SQR(C^ 2 + A^ 2 / 4):
      V = A * B * C / 3:
      GOTO 800
 6800 HGR :
      Q$ = "E) TRUNCATED PYRAMID":
      C% = 0:
      R% = 0:
      GOSUB 780:
      DRAW 10 AT 205,115:
      GOSUB 700:
      IF R% = 1 GOTO 3400
 7100 I = 1201201:
      G = A:
      GOSUB 450:
      I = 148120:
      HOME :
      VTAB 21:
      GOSUB 480:
      A = G
 7200 I = 2100952:
      G = B:
      GOSUB 450:
      I = 238095:
      GOSUB 480:
      B = G
 7300 I = 1300383:
      G = C:
      GOSUB 450:
      I = 158038:
      GOSUB 480:
      C = G:
      IF A < C THEN
         INVERSE :
         CALL 778:
         PRINT "C MUST BE < "A:
         NORMAL :
         GOTO 7300
 7400 I = 1640554:
      G = D:
      GOSUB 450:
      I = 192055:
      GOSUB 480:
      D = G:
```

```
      IF D > B THEN
         INVERSE :
         CALL 778:
         PRINT "D MUST BE < "B:
         NORMAL :
         GOTO 7400
 7500 I = 1150855:
      G = E:
      GOSUB 450:
      I = 144085:
      GOSUB 480:
      E = G
 7700 GOSUB 380:
      ON R$ = "Y" GOTO 7100:
      S = A * B + C * D + (A + C) * SQR(E^ 2 + (B - D)^ 2 / 4) + (B + D) * SQR(E
      ^ 2 + (A - C)^ 2 / 4):
      V = (B * A^ 2 - D * C^ 2) * E / (A - C) / 3:
      GOTO 800
                              +---------------------------+
 7800                         ! **** ANNULAR SHAPES **** !
                              +---------------------------+
 7850 PRINT D$"BLOAD ANNULAR SHAPES,A2048,V222"
 7900 HGR :
      Q$ = "A) (SLICED) CYLINDER":
      C% = 0:
      R% = 0:
      GOSUB 780:
      DRAW 6 AT 170,105:
      GOSUB 700:
      IF R% = 1 GOTO 8700
 8200 I = 1000341:
      G = A:
      GOSUB 450:
      I = 128034:
      HOME :
      VTAB 21:
      GOSUB 480:
      A = G
 8300 I = 1001102:
      G = B:
      GOSUB 450:
      I = 128110:
      GOSUB 480:
      B = G
 8400 I = 850733:
      DRAW 7 AT 110,105:
      G = C:
      GOSUB 450:
      I = 117073:
      GOSUB 480:
      C = G
 8600 GOSUB 380:
```

```
      ON R$ = "Y" GOTO 8200:
      S = PI * C * (A + B + (C + SQR(C * C + (ABS(B - A))^ 2)) / 2) / 2:
      V = PI * C * C * (A + B) / 8:
      GOTO 800
 8700 HGR :
      Q$ = "B) ANNULUS":
      C% = 0:
      R% = 0:
      GOSUB 780:
      DRAW 8 AT 170,100:
      GOSUB 700:
      IF R% = 1 GOTO 9800
 9000 I = 900241:
      DRAW 9 AT 170,74:
      G = A:
      GOSUB 450:
      I = 118024:
      HOME :
      VTAB 21:
      GOSUB 480:
      A = G
 9100 I = 900372:
      DRAW 10 AT 138,75:
      G = B:
      GOSUB 450:
      I = 118037:
      GOSUB 480:
      B = G:
      IF A < B THEN
         R = A:
         GOSUB 620:
         GOTO 9100
 9200 I = 1750903:
      G = C:
      GOSUB 450:
      I = 203090:
      GOSUB 480:
      C = G
 9300 HTAB 5:
      INVERSE :
      PRINT "INNER CIRCUMFERENCE = "FN P2(PI * B)$$U1$:
      HTAB 5
 9400 E = PI * A:
      PRINT "OUTER CIRCUMFERENCE = "FN P2(E)$$U1$:
      NORMAL
 9500 I = 901284:
      DRAW 11 AT 130,121:
      G = D + .00001:
      GOSUB 450:
      I = 118128:
      GOSUB 480:
      D = G:
```

```
      IF D > E THEN
         R = E:
         GOSUB 620:
         GOTO 9500
 9700 GOSUB 380:
      ON R$ = "Y" GOTO 9000:
      F = (PI * A - D) / A:
      S = F * (A * B) * (C + (A - B) / 2) + G * (A - B) * (D > 0):
      V = F * C * (A^ 2 - B^ 2) / 4:
      GOTO 800
 9800 HGR :
      Q$ = "C) TORUS":
      C% = 0:
      R% = 0:
      GOSUB 780:
      DRAW 12 AT 170,95:
      GOSUB 700:
      IF R% = 1 GOTO 10700
10100 I = 950391:
      DRAW 13 AT 161,87:
      G = A:
      GOSUB 450:
      I = 123039:
      HOME :
      VTAB 21:
      GOSUB 480:
      A = G
10200 I = 1521232:
      DRAW 14 AT 170,120:
      G = B:
      GOSUB 450:
      I = 152133:
      GOSUB 480:
      B = G:
      IF A < B THEN
         R = A:
         GOSUB 620:
         GOTO 10200
10300 D = PI * A:
      HTAB 5:
      INVERSE :
      PRINT "CIRCUMFERENCE = "FN P2(D)$6U16:
      NORMAL
10400 I = 951173:
      DRAW 15 AT 134,109:
      G = C + .00001:
      GOSUB 450:
      I = 95127:
      GOSUB 480:
      C = G:
      IF C > D THEN
         R = D:
```

```
         GOSUB 620:
         GOTO 10400
10600 GOSUB 380:
      ON R$ = "Y" GOTO 10100:
      F = (PI * A - C) / A:
      S = PI * A * B * F + PI * B * B / 2 * (D > 0):
      V = PI * B * B * A * F / 4:
      GOTO 800
10700 HGR :
      Q$ = "D) HEMI-SPHERE":
      A$ = Q$:
      :
      C% = 0:
      R% = 0:
      GOSUB 780:
      DRAW 16 AT 170,105:
      GOSUB 700:
      IF R% = 1 GOTO 11300
11000 I = 1001061:
      DRAW 17 AT 165,105:
      G = A:
      GOSUB 450:
      I = 100117:
      HOME :
      VTAB 21:
      GOSUB 480:
      A = G
11200 GOSUB 650:
      GOSUB 380:
      ON R$ = "Y" GOTO 11000:
      E = (A - 2 * D) * (D > 0):
      S = PI * (3 * A^ 2 + 2 * C * E^ 2) / 4:
      V = PI * (A^ 3 - E^ 3) / 12:
      GOTO 800
11300 HGR :
      Q$ = "E) SECTION OF SPHERE":
      C% = 0:
      R% = 0:
      GOSUB 780:
      DRAW 18 AT 170,100:
      GOSUB 700:
      IF R% = 1 GOTO 7900
11600 I = 780721:
      DRAW 19 AT 101,100:
      G = A:
      GOSUB 450:
      I = 107072:
      HOME :
      VTAB 21:
      GOSUB 480:
      A = G
11700 I = 921032:
```

```
      DRAW 20 AT 167,100:
      G = B:
      GOSUB 450:
      I = 92117:
      GOSUB 480:
      B = G
11900 GOSUB 650:
      GOSUB 380:
      ON R$ = "Y" GOTO 11600:
      E = (A - D) * (D > 0):
      F = (B - 2 * D) * (D > 0):
      S = PI * (A^ 2 + B^ 2 / 2 + (E^ 2 + F^ 2 / 4) * C):
      V = PI * (A * (A^ 2 + .75 * B^ 2) - E * (E^ 2 + .75 * F^ 2)) / 6:
      GOTO 800
                              +--------------------------+
12300                         ! **** COMPLEX SHAPES **** !
                              +--------------------------+
12400 PRINT D$"BLOAD RECTANGULAR SHAPES.A2048,V222":
      D% = 2:
      ONERR GOTO 15400
12600 PRINT D$"VERIFY TAB.INFORMATION":
      PRINT D$"OPEN TAB.INFORMATION":
      PRINT D$"READ TAB.INFORMATION":
      INPUT T:
      INPUT B:
      INPUT C:
      INPUT D:
      INPUT E:
      PRINT :
      PRINT D$"CLOSE":
      ONERR GOTO 15500
12700 HGR :
      HCOLOR= 3:
      PRINT D$"PR#"T:
      PRINT "D,S"INT((D - B + 70) / 140)",M1.X"2 * B",Y"(C + INT(INT(D - B + E -
       C) / 11) / 2) * 2",R":
      ON PEEK(3091) = 24 AND PEEK(3094) = 192 GOTO 12900:
      ONERR GOTO 15600
12800 PRINT D$"BLOAD QUICK-DRAW":
      POKE 3089,0:
      POKE 3090,0:
      POKE 3091,24:
      POKE 3092,1:
      POKE 3093,0:
      POKE 3094,192
12900 POKE 216,0:
      HPLOT 0,0 TO 0,159 TO 279,159 TO 279,0 TO 0,0
                         +-----------------------------------+
13000                    !  CALIBRATE TABLET DISTANCE SCALE  !
                         +-----------------------------------+
13100 PRINT D$"PR#0":
      HOME :
```

```
      VTAB 21:
      PRINT "CALIBRATION OF DISTANCE ON TABLET:":
      PRINT :
      HTAB 13:
      CALL 778:
      PRINT "BEGINNING POINT?":
      VTAB 10
13200 PRINT D$"IN#"T:
      INPUT B,C,F:
      IF F < 0 THEN
         PRINT D$"IN#0":
         GET A$:
         ON ASC(A$) = 13 GOTO 2000
13300 IF F <  > 2 THEN
         PRINT :
         GOTO 13200
13400 ON B < 0 OR B > 279 OR C < 0 OR C > 191 GOTO 13100
                                          +---+
13500                                     !   !
                                          +---+
13600 HPLOT B,C:
      VTAB 23:
      HTAB 13:
      CALL 778:
      PRINT "ENDING POINT?    ":
      VTAB 10
13700 PRINT D$"IN#"T:
      INPUT D,E,F:
      IF F < 0 THEN
         PRINT D$"IN#0":
         GET A$:
         ON ASC(A$) = 13 GOTO 2000
13800 IF F <  > 2 THEN
         PRINT :
         GOTO 13700
13900 ON D < 0 OR D > 279 OR E < 0 OR E > 191 GOTO 13600:
      HPLOT B,C TO D,E:
      HOME :
      A = SQR((D - B + 1)^ 2 + (E - C + 1)^ 2):
      PRINT D$"IN#0":
      CALL 778
13950 VTAB 21:
      PRINT "HOW MANY ";:
      INVERSE :
      PRINT U1$;:
      NORMAL :
      PRINT " BETWEEN THOSE POINTS ":
14000 G = 0:
      C% = 300:
      GOSUB 510:
      H = A / G
```

```
14100                        !  AREA/PERIMETER MEASUREMENT  !
                             +-----------------------------+
14200 PRINT :
      PRINT D$"PR#"T:
      PRINT "T1,C":
      PRINT D$"PR#0":
      HOME :
      VTAB 4
14300 PRINT "   FOR A COMPLEX SHAPE, YOU MUST DRAW   THE CROSS-SECTIONAL PROFILE
       ON THE      TABLET IN ONE CONTINUOUS LINE, RAISING  THE PEN ONLY WHEN THE
       PROFILE IS        COMPLETE."
14400 PRINT :
      PRINT :
      PRINT "   THE COMPUTER WILL AUTOMATICALLY JOIN THE END POINT TO THE BEGINN
      ING WHEN YOU LIFT THE PEN.  THEN THE PROGRAM WILL    CALCULATE THE PERIMET
      ER AND AREA OF THE CROSS-SECTION."
14500 VTAB 20:
      PRINT "   PRESS ";:
      INVERSE :
      PRINT "RETURN";:
      NORMAL :
      PRINT " WHEN READY TO DRAW ";:
      GET A$
14600 PRINT :
      PRINT D$"PR#"T:
      PRINT "M1":
      PRINT D$"PR#0":
      HCOLOR= 0:
      HPLOT 0,0:
      CALL 62454:
      HCOLOR= 3:
      HPLOT 0,0 TO 0,159 TO 279,159 TO 279,0 TO 0,0
14700 PRINT D$"IN#"T:
      N% = 1:
      CALL 3072:
      ON PEEK(700) = 0 GOTO 15300:
      ON N% < 10 GOTO 14600:
      HPLOT X%(1),Y%(1) TO X%(N% - 1),Y%(N% - 1)
14800 PRINT D$"IN#0":
      CALL 778:
      HOME :
      VTAB 21:
      PRINT "DO YOU WANT TO RE-DO THE PROFILE? ";:
      GOSUB 390:
      ON R$ = "Y" GOTO 14600:
      VTAB 23:
      HTAB 14:
      PRINT "CALCULATING..."
14900 V = 0:
      S = 0:
      D = N% - 1:
      FOR I = 2 TO D:
```

```
         A = X%(I) - X%(I - 1):
         B = Y%(I):
         C = Y%(I - 1):
         V = (B + C) * A / 2 + V:
         S = SQR((B - C)^ 2 + A * A) + S:
      NEXT
15000 A = X%(1) - X%(N% - 1):
      V = V + A * ((Y%(1) + Y%(N% - 1)) / 2):
      S = S + SQR(A * A + (Y%(1) - Y%(N% - 1))^ 2):
      V = FN P2(ABS(V) / H^ 2):
      S = FN P2(S / H)
15100 HOME :
      CALL 778:
      VTAB 21:
      PRINT "     AREA IS "V;S$U3$:
      PRINT "PERIMETER IS "S;S$U1$:
      PRINT :
      PRINT "IS THE SECTION AN ANNULUS? ";:
      GOSUB 390:
      PRINT
15110 IF R$ <  > "Y" THEN
         PRINT "LENGTH OF SECTION ("U1$"): ";:
         G = 0:
         GOSUB 510:
         S = S * G + 2 * V:
         V = V * G:
         GOTO 800
15150 PRINT "EFFECTIVE RADIUS OF ANNULUS ("U1$"): ";:
      G = 0:
      GOSUB 510:
      L = 2 * PI * G:
      S = S * L:
      V = V * L:
      GOTO 800
                        +-----------------------------------+
15200                   !  TABLET INTERRUPTED BY KEYPRESS   !
                        +-----------------------------------+
15300 PRINT :
      PRINT D$"PR#0":
      PRINT D$"IN#0":
      GET A$:
      ON ASC(A$) <  > 27 GOTO 2000:
      TEXT :
      HOME :
      CALL 778:
      VTAB 10:
      HTAB 13:
      PRINT "RETURN TO MENU? ";:
      GOSUB 390:
      ON R$ = "Y" GOTO 2000:
      PRINT :
      PRINT D$"PR#"T:
```

```
      PRINT "M1":
      GOTO 13100
                              +---------------------------+
15350                         !  ERROR EXITS FROM TABLET  !
                              +---------------------------+
15400 CALL 778:
      HOME :
      VTAB 10:
      PRINT "  I NEED THE FILE   ";:
      FLASH :
      PRINT "TAB.INFORMATION":
      NORMAL :
      PRINT :
      PRINT "ON THE PROGRAM DISK IN ORDER USE THE":
      PRINT :
      PRINT "GRAPHICS TABLET FOR A COMPLEX SHAPE.":
      GOTO 15800
15500 CALL 778:
      PRINT D$"PR#0":
      TEXT :
      HOME :
      VTAB 10:
      PRINT "  I CANNOT USE THE GRAPHICS TABLET":
      PRINT :
      PRINT "UNLESS THE BINARY FILE  ";:
      FLASH :
      PRINT "QUICK-DRAW":
      NORMAL :
      PRINT :
      PRINT "IS ON THE PROGRAM DISK.":
      GOTO 15800
15600 CALL 778:
      PRINT D$"PR#0":
      TEXT :
      HOME :
      VTAB 10:
      PRINT "   YOU CANNOT USE THIS OPTION UNLESS":
      PRINT :
      PRINT "THE GRAPHICS TABLET INTERFACE CARD IS":
      PRINT :
      PRINT "INSTALLED IN SLOT # ";:
      FLASH :
      PRINT " "T" ";:
      NORMAL
15700 PRINT " AS SPECIFIED":
      PRINT :
      PRINT "IN THE DATA FILE   ";:
      INVERSE :
      PRINT "TAB.INFORMATION":
      NORMAL :
      GOTO 15800
15800 VTAB 23:
```

```
      PRINT "  PRESS ";:
      INVERSE :
      PRINT "RETURN";:
      NORMAL :
      PRINT " TO CONTINUE...";:
      GET R$:
      GOTO 2000
                           +---------------------------+
15900                      !  *** RISER SIZE/NECK ***  !
                           +---------------------------+
16000 T = R%:
      HOME :
      FOR I = 1 TO 9:
         FOR J = 0 TO I - 1:
            ON ABS(AJ(I,J) - AJ(J,I)) =  < .01 * AJ(I,J) GOTO 16100:
            HOME :
            VTAB 5:
            CALL 778:
            PRINT "INCONSISTENT JUNCTION AREAS":
            PRINT "   BETWEEN SUB-SECTIONS ";:
            INVERSE :
            PRINT S$I;S$;
16010       NORMAL :
            PRINT " AND ";:
            INVERSE :
            PRINT S$J;S$:
            NORMAL :
            PRINT :
            PRINT :
            PRINT "   1. SET AREA = ";:
            INVERSE :
            PRINT S$FN P2(AJ(I,J))S$;:
            NORMAL :
            PRINT S$U3$:
            PRINT :
            PRINT "   2. SET AREA = ";:
            INVERSE
16020       PRINT S$FN P2(AJ(J,I))S$;:
            NORMAL :
            PRINT S$U3$:
            PRINT :
            PRINT "   3. RETURN TO SHAPE MENU":
            PRINT :
            PRINT :
            L% = 3:
            :
            GOSUB 320:
            IF R% = 3 THEN
               J = I - 1:
               I = 10:
               GOTO 16100
16030       AJ(I,J) = AJ(I,J) * (R% = 1) + AJ(J,I) * (R% = 2):
```

```
            AJ(J,I) = AJ(I,J)
16100     NEXT :
      NEXT :
      ON I > 10 GOTO 2000:
      ON T <  > 5 GOTO 20200:
      POKE 34,0:
      HOME :
      HTAB 7:
      INVERSE :
      PRINT "  RISER SIZE/NECK  ":
      HTAB 7:
      PRINT SPC( 19)"":
      NORMAL :
      VTAB 5:
      HTAB 7
16200 PRINT "SUB-   WEIGHT  MODULUS":
      HTAB 5:
      PRINT "SECTION   ("U2$")     ("U1$")":
      PRINT :
      AC = 0:
      CN = 0:
      MC = 0:
      NN = 0:
      SC = 0:
      VC = 0:
      L% = 6:
      Q = 0:
      FOR I = 0 TO 9:
         ON VC(I) = 0 GOTO 16400:
         IF SC(I) = 0 THEN
            SC(I) = VC(I) / 20
16300    AC = AC + AC(I):
         CN = CN + CN(I):
         SC = SC + SC(I):
         VC = VC + VC(I):
         NN = NN + 1:
         HTAB 9:
         PRINT I;:
         HTAB 13:
         D% = 1:
         R = VC(I) * DF:
         GOSUB 245:
         HTAB 22:
         R = VC(I) / SC(I):
         D% = 2:
         GOSUB 245:
         PRINT :
         IF R > Q THEN
            Q = R:
            SR = I
16400 NEXT :
      IF VC THEN 16500
```

```
16450 VTAB 10:
      CALL 778:
      PRINT "CANNOT FIND RISER SIZE UNTIL AFTER":
      PRINT :
      HTAB 6:
      FLASH :
      PRINT " CASTING SHAPE/SIZE ":
      NORMAL :
      PRINT :
      PRINT "   OPTION HAS BEEN COMPLETED.":
      CALL 778:
      PRINT :
      GOSUB 235:
      GOTO 2000
16500 ON NN = 1 GOTO 20200:
      PRINT :
      PRINT :
      PRINT "   THERE ARE ";:
      INVERSE :
      PRINT S$NN;S$;:
      NORMAL :
      PRINT " SUB-SECTIONS.":
      PRINT :
      PRINT "ON WHICH SUB-SECTION":
      PRINT "WILL THE RISER BE PLACED? "SR;CHR$(8);
16600 G = SR:
      C% = 300:
      GOSUB 510:
      SR = G:
      IF VC(G) = 0 THEN
         CALL 778:
         HTAB 27:
         CALL  - 958:
         GOTO 16600
                        +-----------------------------------+
20000                   !  *** RETURN TO MAIN PROGRAM ***  !
                        +-----------------------------------+
20200 VTAB 20:
      CALL  - 958:
      PRINT :
      HTAB 8:
      INVERSE :
      PRINT " PLEASE WAIT WHILE ":
      HTAB 8:
      PRINT " PROGRAM IS LOADED ":
      NORMAL
20300 PRINT D$"OPEN SCRATCH2,V222":
      PRINT D$"WRITE SCRATCH2":
      PRINT U0$","U1$","U2$","U3$","U4$","U5$","U6$","AC","AN","CN","DF","IC","I
      W","LS","MM","N","NC","NN","NR","NV","RN","RV","SC","SL","SN","SP","SR","S
      S","VC","VN","WT
20400 FOR I = 0 TO 9:
```

```
      PRINT AC(I)","CN(I)","SC(I)","VC(I):
   NEXT :
   FOR I = 0 TO 9:
      FOR J = 0 TO 9:
         PRINT AJ(I,J):
      NEXT :
   NEXT :
   PRINT CHR$(4)"CLOSE":
   IF T = 5 THEN
      PRINT D$"RUN RISER SIZE/NECK"
20500 POKE 104,8:
   POKE 2048,0:
   PRINT D$"RUN CANMET MAIN PROGRAM"
```

```
63998                    +----------------------------+
63998                    !                            !
63998                    ! 11 APR 1984                !
63998                    !                            !
64000                    ! M.R. VINER                 !
64000                    ! METALLURGICAL ENGINEERING  !
64000                    ! QUEEN'S UNIVERSITY         !
64000                    ! KINGSTON, ONTARIO  K7L 3N6 !
                         +----------------------------+
```

VARIABLE CROSS REFERENCE:

A	440	930	950	960	980	981	982	984	990	1010	1020	1045
	1050	3700	4100	4500	5000	5400	5900	6300	6700	7100	7300	7700
	8200	8600	9000	9100	9400	9700	10100	10200	10300	10600	11000	11200
	11600	11900	13900	14000	14900	15000						
AS	650	850	870	890	905	10700	13200	13700	14500	15300		
AC	1930	3200	16200	16300	20300							
AC(	1090	1940	3200	16300	20400							
AJ(	1080	1940	3200	16000	16010	16020	16030	20400				
AN	1930	3200	20300									
B	440	930	950	981	982	983	984	990	1010	1020	1045	1050
	3800	4100	4600	5000	5500	5900	6400	6700	7200	7400	7700	8300
	8600	9100	9300	9700	10200	10600	11700	11900	12600	12700	13200	13400
	13600	13900	14900									
C	440	660	1030	1045	1050	3900	4100	4700	5000	5600	5900	6500
	6700	7300	7700	8400	8600	9200	9700	10400	10600	11200	11900	12600
	12700	13200	13400	13600	13900	14900						
C%	450	480	605	650	750	780	800	865	890	910	3400	4200
	5100	6000	6800	7900	8700	9800	10700	11300	14000	16600		
CN	1930	3200	16200	16300	20300							
CN(	1090	1940	3200	16300	20400							
D	440	650	4800	5000	5700	5900	7400	7700	9500	9700	10300	10400
	10600	11200	11900	12600	12700	13700	13900	14900				
DS	1910	1930	1940	3350	7850	12400	12600	12700	12800	13100	13200	13700
	13900	14200	14600	14700	14800	15300	15500	15600	20300	20400	20500	
D%	245	250	255	12400	16300							
DF	1930	16300	20300									
E	440	7500	7700	9400	9500	11200	11900	12600	12700	13700	13900	
F	440	9700	10600	11900	13200	13300	13700	13800				
FS	245	255										
G	440	600	605	650	930	960	981	982	990	1020	1030	1060
	1080	3700	3800	3900	4500	4600	4700	4800	5400	5500	5600	5700
	6300	6400	6500	7100	7200	7300	7400	7500	8200	8300	8400	9000
	9100	9200	9500	10100	10200	10400	11000	11600	11700	14000	15110	15150
	16600											
H	14000	15000										
I	450	480	780	830	840	1080	1090	1940	2000	3700	3800	3900
	4500	4600	4700	4800	5400	5500	5600	5700	6300	6400	6500	7100
	7200	7300	7400	7500	8200	8300	8400	9000	9100	9200	9500	10100
	10200	10400	11000	11600	11700	14900	16000	16010	16020	16030	16100	16200
	16300	20400										
IC	1930	3200	20300									
IW	1930	3200	20300									
J	1070	1072	1080	1940	3200	16000	16010	16020	16030	20400		
L	520	780	15150									
L%	255	330	510	560	570	600	605	700	910	2200	16020	16200
LS	1930	3200	20300									
MC	3200	16200										
MM	1930	3200	20300									
N	750	830	840	1072	1080	1090	1930	2600	3000	3200	20300	
N%	14700	14900	15000									

```
  NC     1930   3200  20300
  NN     1930  16200  16300  16500  20300
  NR     1930   3200  20300
  NV     1930   3200  20300
  P2(     620    750    800   1910   9300   9400  10300  15000  16010  16020
  PI      980    984   1010   1910   8600   9300   9400   9700  10300  10600  11200  11900
        15150
  Q       850    865    870   1070   1080   1090  16200  16300
  Q$      460    510    560    570    605    750    780    800    830    865    890    900
          905   3400   4200   5100   6000   6800   7900   8700   9800  10700  11300
  R       245    450    460    620    780   1910   2900   9100   9500  10200  10400  16300
  R$      210    245    250    255    330    340    390    400    450    480    520    560
          570    650    660    820    830    850    860    940    970    983   1000   1040
         1070   1072   2600   2900   3000   4100   5000   5900   6700   7700   8600   9700
        10600  11200  11900  14800  15110  15300  15800
  R%      250    255    330    450    480    700    750    780    800    865    890    900
          905    910   2200   3400   4200   5100   6000   6800   7900   8700   9800  10700
        11300  16000  16020  16030
  RN     1930  20300
  RV     1930   3200  20300
  S       800    840    950    980    984   1010   1045   1050   1060   1080   1090   4100
         5000   5900   6700   7700   8600   9700  10600  11200  11900  14900  15000  15100
        15110  15150
  S$      605   1910   2600   3000   9300   9400  10300  15100  16000  16010  16020  16500
  SC     1930   3200  16200  16300  20300
  SC(     750    840   1080   1940   3200  16200  16300  20400
  SL     1930   3200  20300
  SN     1930   3200  20300
  SP     1930   3200  20300
  SR     1930   3200  16300  16500  16600  20300
  SS     1930   3200  20300
  T     12600  12700  13200  13700  14200  14600  14700  15300  15600  16000  16100  20400
  U0$    1930  20300
  U1$     480    650    930    960    981    990   1020   1030   1930   9300   9400  10300
        13950  15100  15110  15150  16200  20300
  U2$    1930  16200  20300
  U3$     800   1060   1930  15100  16010  16020  20300
  U4$     800   1930  20300
  U5$    1930  20300
  U6$    1930  20300
  V       800    830    840   1900   4100   5000   5900   6700   7700   8600   9700  10600
        11200  11900  14900  15000  15100  15110  15150
  VC     1900   1930   3200  16200  16300  16400  20300
  VC(     750    830    840   1940   3000   3200  16200  16300  16600  20400
  VN     1930   3200  20300
  WT     1930   3200  20300
  X$      255    605    865   1910
->X%(    1910  14700  14900  15000
->Y%(    1910  14700  14900  15000
```

NOTES:

****

* INDICATES SYMBOL REFERENCED AT ONE LINE NUMBER ONLY.
** INDICATES SYMBOL EQUIVALENT TO PREVIOUSLY DEFINED SYMBOL.
-> INDICATES UNDEFINED SYMBOL.

LINE NUMBER 99999 ==> TOO MANY REFERENCES TO THE VARIABLE;
LATER REFERENCES ARE NOT LISTED.

```
                          +-------------------------+
 10                       ! ********************** !
 10                       ! * CANMET RISERING 2.1 * !
 10                       ! *                    * !
 10                       ! *   RISER SIZE/NECK  * !
 10                       ! ********************** !
                          +-------------------------+
100 ON PEEK(104) <  > 64 OR PEEK(6380) <  > 96 GOTO 300:
    ONERR GOTO 300
200 PRINT CHR$(4)"VERIFY SCRATCH2.V222":
    POKE 216,0:
    GOTO 10000
300 POKE 216,0:
    HOME :
    VTAB 10:
    PRINT "  CANNOT RUN ";:
    INVERSE :
    PRINT " RISER SIZE/NECK ":
    NORMAL :
    PRINT :
    PRINT "EXCEPT FROM CANMET RISERING PACKAGE"
350 VTAB 16:
    PRINT "   TO DO SO, TYPE ";:
    INVERSE :
    PRINT " RUN HELLO ":
    NORMAL :
    PRINT :
    END
                          +-------------------------+
400                       !   *** SUBROUTINES ***   !
                          +-------------------------+
500 GET R$:
    IF R$ = CHR$(16) THEN
       CALL 800:
       GOTO 500
600 RETURN
                                      +---+
700                                   !   !
                                      +---+
780 POKE 5889,0:
    POKE 5890,C%:
    POKE 5891,R%:
    L = LEN(Y$):
    FOR I = 1 TO L:
       Z = ASC(MID$(Y$,I,1)):
       POKE 5893,Z:
       CALL 6381:
    NEXT :
    RETURN
                                      +---+
790                                   !   !
                                      +---+
```

```
1200 INVERSE :
     HTAB 1:
     PRINT Q$;:
     NORMAL :
     PRINT S$;
1300 N% = 1
1400 L% = 1:
     Q$ = ""
1500 GET R$:
     L = ASC(R$):
     ON L = 13 GOTO 2300:
     ON L = 8 GOTO 2000:
     IF L < 32 OR (N% AND (L < 46 OR L = 47 OR L > 57)) THEN
        CALL 778:
        GOTO 1500
1900 PRINT R$;:
     L% = L% + 1:
     Q$ = Q$ + R$:
     GOTO 1500
2000 L% = L% - 1:
     ON L% < 1 GOTO 1400:
     PRINT R$" "R$;:
     ON L% = 1 GOTO 1400:
     Q$ = LEFT$(Q$,L% - 1):
     GOTO 1500
2300 IF N% THEN
        R = VAL(S$ + Q$) + R * (L% = 1):
        IF L% = 1 AND NOT R THEN
           CALL 778:
           GOTO 1500
2400 RETURN
                                        +---+
2600                                    !   !
                                        +---+
2700 HOME :
     HTAB (34 - LEN(M$(RT))) / 2:
     INVERSE :
     PRINT M$(RT):
     NORMAL :
     RETURN
                                        +---+
2800                                    !   !
                                        +---+
2900 VTAB 24:
     HTAB 1:
     PRINT "CHANGE ANY OF THE ABOVE?  ";:
     CALL  - 958
3000 INVERSE :
     PRINT "Y/N";:
     NORMAL :
     PRINT " ";:
     GOSUB 500:
```

```
      IF R$ = "y" THEN
         R$ = "Y"
 3100 HTAB 1:
      RETURN
                                          +---+
 3200                                     !   !
                                          +---+
 3300 VTAB 24:
      HTAB 1:
      PRINT "PRESS <RETURN> TO LEAVE ENTRY UNCHANGED";:
      HTAB 1:
      RETURN
                                          +---+
 3400                                     !   !
                                          +---+
 3500 PRINT "WHICH?  PRESS A NUMBER KEY...  ";
 3600 GOSUB 500:
      R% = VAL(R$):
      IF R% < 1 OR R% > L% THEN
         CALL 778:
         GOTO 3600
 3700 PRINT R$:
      RETURN
                                          +---+
 3800                                     !   !
                                          +---+
 3900 VTAB 24:
      HTAB 1:
      CALL  - 958:
      HTAB 3:
      INVERSE :
      PRINT " PRESS SPACE BAR TO CONTINUE.....";:
      NORMAL :
      GOSUB 500:
      VTAB 1:
      PRINT :
      RETURN
                                          +---+
 4000                                     !   !
                                          +---+
 4100 PRINT RIGHT$(X$ + STR$(INT(R)),L%);:
      RETURN
 4200 R$ = STR$(INT(R * 10^ C% + .5)):
      Q$ = "":
      IF LEFT$(R$,1) = "-" THEN
         R$ = RIGHT$(R$,LEN(R$) - 1):
         Q$ = "-"
 4300 R% = LEN(R$):
      IF R% < C% + 1 THEN
         R$ = "0" + R$:
         GOTO 4300
 4400 PRINT RIGHT$(X$ + Q$ + LEFT$(R$,R% - C%) + "." + RIGHT$(R$,C%),L%);:
```

```
      RETURN
                          +--------------------------------------+
4500                      !  GET RISER SLEEVE VALUES FROM DISK  !
                          +--------------------------------------+
4600 PRINT D$"READ "F$",R"M:
      INPUT A$:
      PRINT CHR$(4):
      R$ = LEFT$(A$,1):
      RD = VAL(MID$(A$,2,6)):
      LS = VAL(MID$(A$,8,6)):
      A = VAL(MID$(A$,14,4)):
      CS = VAL(MID$(A$,18,7))
4700 IF R$ = "I" AND UO$ = "M" THEN
         RD = FN P2(RD * 2.54):
         LS = LS * 2.54
4800 IF R$ = "M" AND UO$ = "I" THEN
         RD = FN P2(RD / 2.54):
         LS = LS / 2.54
4900 RETURN
                                              +--+
5000                                          !  !
                                              +--+
5100 IF G >  = .5 AND G <  = 2 THEN
         RETURN
5110 Q$ = "LARGE":
      IF G < .5 THEN
         Q$ = "SMALL"
5120 CALL 778:
      PRINT :
      PRINT "HT/DIAM TOO "Q$" TO BE ECONOMICAL!":
      PRINT :
      PRINT :
      PRINT "   CONTINUE ANYWAY? ";:
      GOSUB 3000:
      IF R$ = "Y" THEN
         RETURN
5130 POP :
      RD = 0:
      ON R% + 1 GOTO 14600,15400,15400:
      STOP
5140 CALL 778:
      PRINT :
      PRINT :
      PRINT "  IMPRACTICAL: HT/DIAM TOO "Q$:
      RD = 0:
      GOSUB 3900:
      RETURN
5145 IF RH > LS THEN
         CALL 778:
         PRINT :
         PRINT "  THIS SLEEVE IS ONLY  "LS;S$U1$"  LONG.":
         PRINT :
```

```
        PRINT "  IT SHOULD BE AT LEAST  "FN P1(RH)5&U1&:
        RD = 0:
        GOSUB 3900:
        POP :
        POP :
        GOTO 14600
5146 RETURN
                                          +---+
5150                                      !   !
                                          +---+
5160 VTAB 5:
     CALL  - 958:
     VTAB 9:
     PRINT "   FINDING RISER SHRINK PROFILE:":
     PRINT :
     PRINT "     FOR ";:
     INVERSE
5170 INVERSE :
     PRINT S$Z$" = "(RD * (R% < 2) + RH * (R% = 2) + G * (R% = 3))S$:
     NORMAL :
     VTAB 15:
     PRINT "    PLEASE BE PATIENT .";:
     RETURN
                    +---------------------------------------+
5200                !                                       !
5200                ! FIND  Y: DISTANCE OF CAVITY BASE FROM !
5200                !   RISER/CASTING JUNCTION AT X=RD/200  !
                    +---------------------------------------+
5205 FOR J = 1 TO NN + 1:
        FOR I = 0 TO NN:
           M(I,J) = 0:
           SS(I,J) = 0:
        NEXT :
        X(J) = 0:
        Y(J) = 0:
     NEXT :
     X(0) = 0:
     Y(0) = 0
5215 CALL 884:
     PRINT ".";:
     RD = 2 * R:
     IF T THEN
        H = G * RD:
        GOTO 5225
5220 G = H / RD
5225 Z = PI * R * R:
     VR = Z * H:
     HH = H:
     H = H - (VC + VR) * DT * .0001 / Z:
     MR = H / (4 * G + (1.1 + G) * B) / A:
     RF = MR / Z:
     IF Z > S(II) / 6 THEN
```

```
        Z = S(II) / 6
5230 FOR I = 0 TO NN - 1:
        Z(I) = S(I):
        M(I,1) = V(I) / Z(I):
     NEXT :
     Z(II) = S(II) - Z:
     M(II,1) = V(II) / Z(II):
     Z = SQR(R * R - (RD - XM) * XM * A) * (R > XM)
5270 X(0) = R:
     U = R * R / MR:
     FOR J = 1 TO NN:
        L = J - 1:
        Q = L:
        FOR I = L TO NN - 1:
           SS(I,0) = 0:
           T(I) = X(L) * X(L) - U * M(I,J) * (V(I) - SS(I,L)) / V(I):
           IF I = L THEN
              Q = L:
              GOTO 5285
5280       IF T(I) > T(Q) THEN
              Q = I
5285    NEXT :
        ON Q = L GOTO 5355:
        W = V(Q):
        V(Q) = V(L):
        V(L) = W:
        W = Z(Q):
        Z(Q) = Z(L):
        Z(L) = W:
        W = S(Q):
        S(Q) = S(L):
        S(L) = W
5300    FOR I = 1 TO NN + 1:
           W = M(Q,I):
           M(Q,I) = M(L,I):
           M(L,I) = W:
           W = SS(Q,I):
           SS(Q,I) = SS(L,I):
           SS(L,I) = W:
        NEXT :
        IF Q = II OR L = II THEN
           II = L * (Q = II) + Q * (L = II)
5340    FOR I = 0 TO NN - 1:
           IF I <  > Q AND I <  > L THEN
              W = A(Q,I):
              A(Q,I) = A(L,I):
              A(L,I) = W
5345       A(I,Q) = A(Q,I):
           A(I,L) = A(L,I):
        NEXT
5355    X(J) = SQR(T(Q) * (T(Q) > 0)):
        FOR I = L TO NN - 1:
```

```
            SS(I,J) = SS(I,L) + V(I) * (X(L) * X(L) - T(Q)) / M(I,J) / U:
         NEXT
5385     FOR I = L TO NN - 1:
            Z(I) = Z(I) + A(I,L):
            M(I,J + 1) = V(I) / Z(I):
         NEXT
5390  NEXT :
      FOR I = 1 TO NN:
         IF X(I) < = Z AND X(I - 1) > = Z THEN
            K = I
5420  NEXT :
      FOR I = NN + 1 TO K STEP - 1:
         X(I + 1) = X(I):
      NEXT :
      X(K) = Z:
      C(NN + 1) = 0:
      FOR J = 1 TO NN:
         C(J) = 0:
         FOR I = J - 1 TO NN - 1:
            C(J) = C(J) + V(I) / M(I,J):
         NEXT :
      NEXT :
      FOR I = NN + 1 TO K STEP - 1:
         C(I + 1) = C(I):
      NEXT
5460  V = 0:
      FOR I = 1 TO K:
         V = V + C(I) * (X(I - 1) * X(I - 1) - X(I) * X(I)) / U:
      NEXT :
      F = MW * (VC + VR) / (V + PI * H * (R * R - Z * Z)) / 100:
      F = (SH + F) / (1 - SH - F)
5490  Y(0) = H:
      FOR I = 1 TO NN + 1:
         P = (F * (I < = K) + SH * (I > K) / (1 - SH)) * 2:
         W = RF * C(I):
         Z = Y(I - 1) + W:
         C = X(I):
         L = X(I - 1):
         ON I > NN + 1 GOTO 5500:
         Y(I) = 0:
         IF L < > 0 THEN
            Y(I) = (C / L)^ P * Z - W
5500  NEXT :
      N = NN
5520  IF X(N + 1) = 0 THEN
         N = N - 1:
         GOTO 5520
5540  P = (F * (N + 2 < = K) + SH / (1 - SH) * (N + 2 > K)) * 2
5570  H = HH:
      X = RD / 200:
      Y = ((X / X(N + 1))^ P) * (Y(N + 1) + RF * C(N + 2)) - RF * C(N + 2):
      Y1 = Y:
```

```
      CALL 908:
      RETURN
                          +---------------------------------+
5590                      !  CHECK FOR BAD RISER PLACEMENT  !
                          +---------------------------------+
5600 IF II = NN - 1 THEN
        RETURN
5610 GOSUB 2700:
      VTAB 10:
      CALL 778:
      PRINT "  THIS CASTING CANNOT BE FED":
      PRINT "  WITH THE RISER ON SUB-SECTION "SR:
      PRINT :
      PRINT :
      PRINT "  CONTINUE ANYWAY? ";:
      GOSUB 3000:
      IF R$ = "Y" THEN
         RETURN
5615 VTAB 13:
      PRINT :
      PRINT " CHOOSE ANOTHER SUBSECTION: ";
5620 GET R$:
      R = VAL(R$):
      IF R > 9 OR R = SR OR VC(R) = 0 THEN
         CALL 778:
         GOTO 5620
5630 PRINT R:
      SR = R:
      RT = 0:
      POP :
      POP :
      GOTO 10455
                          +---------------------------------+
5800                      !  RISER HEIGHT FOR FIXED DIAM    !
                          +---------------------------------+
5810 GOSUB 5160:
      S = MC * (MC < 3) + 3 * (MC >  = 3):
      H = 9.4 * S * A * B:
      E = 0:
      R = RD / 2
5815 GOSUB 5205:
      ON Y < H / 5 OR X(NN + 1) = 0 GOTO 5820:
      ON E = 2 GOTO 5830:
      E = 1:
      H = H - S:
      GOTO 5815
5820 ON E = 1 GOTO 5835:
      E = 2:
      H = H + S:
      ON H < 8 * R GOTO 5815:
      Q$ = "LARGE":
      GOSUB 5140:
```

```
      GOSUB 2700:
      POP :
      GOTO 15400
 5830 S = S / 2:
      H = H - S:
      GOTO 5840
 5835 S = S / 2:
      H = H + S
 5840 GOSUB 5205:
      ON S < H / 200 GOTO 5860:
      ON Y < H / 5 OR X(NN + 1) = 0 GOTO 5835:
      GOTO 5830
 5860 GOSUB 5600:
      H = 1.2 * H:
      GOSUB 5205:
      RH = H + .1 * RD * (RT = 1 OR RT = 5) + TI * (RT = 2):
      ON RT < 4 GOSUB 5145:
      RETURN
                              +---------------------------+
 5900                         !                           !
 5900                         ! RISER DIAM FOR FIXED HT   !
 5900                         !    OR FIXED HT/DIAM       !
                              +---------------------------+
 5910 S = MC * (MC < 3) + 3 * (MC >  = 3):
      R = 4.7 * S * A * B:
      E = 0
 5915 GOSUB 5205:
      ON Y < H / 5 OR X(NN + 1) = 0 GOTO 5920:
      ON E = 2 GOTO 5930:
      E = 1:
      R = R - S:
      GOTO 5915
 5920 ON E = 1 GOTO 5935:
      E = 2:
      R = R + S:
      ON R < 2.00 * H OR T GOTO 5915:
      Q$ = "SMALL":
      GOSUB 5140:
      POP :
      GOTO 15400
 5930 S = S / 2:
      R = R - S:
      GOTO 5940
 5935 S = S / 2:
      R = R + S
 5940 GOSUB 5205:
      ON S < RD / 200 GOTO 5960:
      ON Y < H / 5 OR X(NN + 1) = 0 GOTO 5935:
      GOTO 5930
 5960 GOSUB 5600:
      R = 1.10 * R:
      GOSUB 5205:
```

```
      RETURN
                                              +--+
5970                                          !  !
                                              +--+
5980 VTAB 9:
     HTAB 1:
     CALL  - 868:
     G = 1:
     T = 1:
     INVERSE :
     PRINT "CALCULATING .";:
     GOSUB 5910:
     T = 0:
     VTAB 9:
     HTAB 1:
     PRINT "SUGGESTED DIAM FOR  H/D=1  IS:  "FN P1(RD)S$U1$:
     NORMAL :
     T(1) = A:
     T(2) = 0:
     T(3) = 0:
     T(4) = 0:
     RETURN
                           +--------------------------+
6100                       ! PROFILE PLOTTING ROUTINE !
                           +--------------------------+
6110 IF RT = 3 OR RT = 6 THEN
        GOSUB 3900:
        RETURN
6120 VTAB 23:
     HTAB 1:
     CALL  - 958:
     PRINT "DO YOU WANT TO SEE":
     HTAB 5:
     PRINT "THE RISER SHRINK PROFILE? ";:
     GOSUB 3000:
     IF R$ <  > "Y" AND R$ <  > "y" GOTO 6210
6130 HGR :
     HOME :
     Y$ = "SHRINK PROFILE FOR:":
     C% = 0:
     R% = 132:
     GOSUB 780:
     Y$ = "RISER DIAMETER = " + STR$(FN P1(RD)) + S$ + U1$ + X$:
     C% = 35:
     R% = 142:
     GOSUB 780
6140 Y$ = "HEIGHT = " + STR$(FN P1(RH)) + S$ + U1$ + X$:
     C% = 91:
     R% = 150:
     GOSUB 780:
     C = 100 / H:
     IF RD > H THEN
```

```
        C = 100 / RD
6150 HPLOT 139.5 - C * R,120.5 - C * H TO 139.5 - C * R,121 TO 140.5 + C * R,12
     1 TO 140.5 + C * R,120.5 - C * H
6160 CALL 884:
     X = 0:
     FOR J = NN + 2 TO 1 STEP  - 1:
        Q = INT(100 * (X(J - 1) - X(J)) / R):
        ON Q <  = 0 GOTO 6200:
        S = (X(J - 1) - X(J)) / Q:
        P = (F * (J <  = K) + SH * (J > K) / (1 - SH)) * 2
6170    W = RF * C(J):
        Z = Y(J - 1) + W:
        L = X(J - 1):
        FOR I = 1 TO Q:
           X = X + S:
           Y = 121 - C * ((X / L)^ P * Z - W):
           IF Y > 121 THEN
              Y = 121
6180       IF J = NN + 1 AND I = 1 THEN
              V = Y
6190       HPLOT 139.5 - C * X,Y + .5:
           HPLOT 140.5 + C * X,Y + .5:
        NEXT
6200 NEXT :
     CALL 908
6205 IF X(NN + 1) = 0 AND Y1 > 0 THEN
        HPLOT 138,121 TO 138,135:
        HPLOT 139,121 TO 139,135:
        HPLOT 140,121 TO 140,135:
        HPLOT 141,121 TO 141,135
                  +-----------------------------------------+
6207              ! OPTIONAL RECALCULATION OF RISER PARAMETERS !
                  +-----------------------------------------+
6210 VTAB 21:
     HTAB 1:
     CALL  - 958:
     PRINT "DO YOU WISH TO DISPLAY THE RISER SHRINK":
     PRINT "   PROFILE FOR A DIFFERENT "Z$"? ";:
     GOSUB 3000:
     IF R$ <  > "Y" THEN
        POKE  - 16303,0:
        RETURN
6220 PRINT :
     INVERSE :
     PRINT "ENTER NEW "Z$" ("U1$"): ";:
     NORMAL :
     PRINT S$;:
     R = 0:
     GOSUB 1300:
     IF LEFT$(Z$,1) = "D" THEN
        R = R / 2:
        GOSUB 5205:
```

```
        RH = H + .1 * RD * (RT = 1 OR RT = 5) + TI * (RT = 2):
        GOTO 6130
6230 RH = R:
     R = RD / 2:
     H = RH - .1 * RD * (RT = 1 OR RT = 5) - TI * (RT = 2):
     GOSUB 5205:
     GOTO 6130
                                          +---+
6300                                      !   !
                                          +---+
6400 YD = INT(100 * VC / (VC + VR + PI * NL * ND * ND / 4)):
     WI = DI * TI * VR / H * (RT = 2)
6500 TW = .025 * PI * TD * RD^ 3 * (RT = 1 OR RT = 5):
     RETURN
                                          +---+
6600                                      !   !
                                          +---+
6700 GOSUB 2700:
     VTAB 7:
     PRINT "APPARENT SURFACE ALTERATION FACTOR:":
     HTAB 31:
     PRINT "TOP = ";B:
     HTAB 30:
     PRINT "SIDE = ";A:
     IF RT = 4 OR RT = 7 THEN
        VTAB 20:
        INVERSE :
        CALL 778:
        PRINT M$(8):
        NORMAL
6800 RETURN
                                          +---+
6900                                      !   !
                                          +---+
6950 VTAB 14:
     PRINT "SLEEVE LENGTH  ("U1$"): ";FN P1(LS * (CS > 0) + RH * (CS < 0));X$
7000 GOSUB 6400:
     VTAB 12:
     INVERSE :
     PRINT R$;:
     NORMAL :
     PRINT " DIAMETER ("U1$"): ";FN P1(RD);X$
7100 VTAB 13:
     PRINT "RISER  HEIGHT  ("U1$"): ";FN P1(RH);X$:
     VTAB 13:
     HTAB 29:
     PRINT "HT/DIAM= ";FN P1(H / RD):
     VTAB 16:
     PRINT "SECTION YIELD:  "YD" % "
7150 IF RT = 2 THEN
        VTAB 18:
        PRINT "TOP INSULATION: ";:
```

```
        INVERSE :
        PRINT FN P3(WI)$$U2$:
        NORMAL
 7200 IF RT = 1 OR RT = 5 THEN
        VTAB 18:
        PRINT "  HOT TOPPING:  ";:
        INVERSE :
        PRINT FN P2(TW)$$U2$:
        NORMAL
 7300 RETURN
                              +---------------------------+
 9999                         !  **** MAIN PROGRAM ****  !
                              +---------------------------+
10000 POKE 51,128:
      ON P% > 0 GOTO 10500:
      D$ = CHR$(13) + CHR$(4):
      S$ = " ":
      X$ = "           ":
      PI = 3.14159:
      DEF FN P1(R) = INT(R * 10 + .5) / 10:
      DEF FN P2(R) = INT(R * 100 + .5) / 100:
      DEF FN P3(R) = INT(R * 1000 + .5) / 1000
10200 HOME :
      VTAB 10:
      CALL  - 958:
      HTAB 7:
      PRINT "PROGRAM IS LOADED":
      PRINT D$"OPEN SCRATCH1,V222":
      PRINT D$"READ SCRATCH1":
      CALL 917:
      INPUT CA$:
      CALL 917:
      INPUT CC$:
      CALL 917:
      INPUT CD$:
      CALL 917:
      INPUT CN$:
      CALL 917:
      INPUT DT$
10300 CALL 917:
      INPUT PO$:
      CALL 917:
      INPUT UN$:
      CALL 917:
      INPUT MM$:
      CALL 917:
      INPUT Q$:
      P$(0) = CHR$(VAL(Q$)):
      FOR I = 1 TO 8:
         CALL 917:
         INPUT M$(I):
         CALL 917:
```

```
**********************************************************************************

         INPUT Q$:
         P$(I) = CHR$(VAL(Q$)):
      NEXT
10350 INPUT CI,CS,DD,DI,FF,MP,MW,NL,NS,P%,PT,RD,RH,RT,SA,SH,TD,TI,TW,VR,XM:
      SH = SH / 100
10400 PRINT D$"OPEN SCRATCH2,V222":
      PRINT D$"READ SCRATCH2":
      INPUT U0$,U1$,U2$,U3$,U4$,U5$,U6$,AC,AN,CN,DF,IC,IW,LS,MM,N,NC,NN,NR,NV,RN
      ,RV,SC,SL,SN,SP,SR,SS,VC,VN,WT:
      DT = (PT - MP) * (.555 + .444 * (U0$ = "M"))
10425 DIM A(9,9),C(12),M(10,11),S(9),SS(10,11),V(9),X(12),Y(12),Z(9)
10450 FOR I = 0 TO 9:
         INPUT AC(I),CN(I),SC(I),VC(I):
      NEXT :
      FOR I = 0 TO 9:
         FOR J = 0 TO 9:
            INPUT AJ(I,J):
         NEXT :
      NEXT :
      PRINT D$"CLOSE"
10455 MC = VC(SR) / SC(SR):
      II = NN - 1:
      IF NN = 1 THEN
         V(0) = VC(SR):
         S(0) = SC(SR):
         GOTO 10500
10460 J = 0:
      FOR I = 0 TO 9:
         IF VC(I) < > 0 AND I < > SR THEN
            V(J) = VC(I):
            S(J) = SC(I):
            T(I) = J:
            J = J + 1
10470 NEXT :
      V(J) = VC(SR):
      S(J) = SC(SR):
      T(SR) = J
10480 FOR J = 0 TO 8:
         FOR K = J + 1 TO 9:
            A(J,K) = 0:
            A(K,J) = 0:
            IF VC(J) AND VC(K) THEN
               A(T(J),T(K)) = AJ(J,K):
               A(T(K),T(J)) = AJ(J,K)
10490    NEXT :
      NEXT
10500 P = 0:
      POKE 34,0:
      HOME :
      HTAB 7:
      INVERSE :
      PRINT "  RISER SIZE/NECK  ":
```

```
      HTAB 7:
      PRINT SPC( 19)"":
      NORMAL :
      I = FRE(0):
      POKE 34,3:
      MC = VC(SR) / SC(SR)
10550 F$ = "":
      ON RT = 0 GOTO 10600:
      VTAB 10:
      PRINT "DO YOU WANT TO REPEAT THE ANALYSIS              ALREADY IN MEMORY? "
      ;:
      GOSUB 3000:
      IF R$ <  > "Y" GOTO 10600
10560 A = SA:
      T(2) = RD:
      T(3) = LS:
      T(4) = CS:
      H = RH - .1 * RD * (RT = 1 OR RT = 5) - TI * (RT = 2):
      F% = 1:
      R% = RT:
      GOTO 10700
10600 HOME :
      VTAB 4:
      FOR I = 1 TO 7:
         PRINT :
         PRINT "  "I"."M$(I):
      NEXT :
      PRINT :
      PRINT "  8. RETURN TO MAIN MENU":
      VTAB 23:
      L% = 8:
      GOSUB 3500:
      IF R% < 8 THEN
         RT = R%
10700 A$ = "SLEEVE ":
      ON R% GOTO 10800,10900,11000,11100,11200,11300,11400,21700
10800 B = 0.7:
      GOSUB 2700:
      GOTO 11900
10900 GOTO 11600
11000 B = .8:
      GOSUB 2700:
      GOTO 11900
11100 B = 2:
      GOSUB 2700:
      GOTO 11900
11200 A$ = "RISER  ":
      A = 1:
      B = 0.7:
      GOTO 15400
11300 A$ = "RISER  ":
      A = 1:
```

```
      B = .8:
      GOTO 15400
11400 A$ = "RISER  ":
      A = 1:
      B = 2:
      GOTO 15400
                                  +------------------+
11500                             !  TOP INSULATION  !
                                  +------------------+
11600 GOSUB 2700:
      VTAB 8:
      PRINT "WHAT IS THE APPARENT SURFACE ALTERATION":
      PRINT :
      PRINT "FACTOR (ASAF) FOR THE TOP INSULATION?":
      PRINT :
      HTAB 15:
      R = 0:
      GOSUB 1300:
      B = R:
      PRINT
11700 IF NOT CI THEN
         VTAB 15:
         PRINT "COST OF TOP INSULATION ($/"U2$"): ";:
         R = 0:
         GOSUB 1300:
         CI = R:
         PRINT
11800 VTAB 18:
      PRINT "THICKNESS OF TOP INSULATION ("U1$"): ";:
      R = 0:
      GOSUB 1300:
      TI = R:
      PRINT
                                  +--------------------+
11850                             !  SLEEVE SELECTION  !
                                  +--------------------+
11900 T(1) = A:
      IF NOT F% THEN
         T(2) = 0:
         T(3) = 0:
         T(4) = 0:
         VTAB 8:
         CALL  - 958:
         PRINT "SELECT FROM STOCK SLEEVES? ";:
         GOSUB 3000:
         IF R$ = "Y" THEN
            GOTO 13100
12000 GOSUB 2700:
      VTAB 6:
      PRINT "APPARENT SURFACE ALTERATION ":
      PRINT "       FACTOR OF THE SLEEVE: ";:
      IF (A) THEN
```

```
          PRINT T(1);:
          HTAB 30:
          IF F% GOTO 12150
12100 R = T(1):
      GOSUB 1300:
      IF R < > T(1) THEN
         A = R:
         PRINT X$:
         GOSUB 5980
12150 VTAB 11:
      HTAB 1:
      PRINT "DIAMETER OF THE SLEEVE ("U1$"):":
      VTAB 13:
      PRINT "LENGTH OF THE SLEEVE   ("U1$"):":
      VTAB 16:
      PRINT "NET COST OF THE SLEEVE ($):":
      VTAB 19:
      PRINT "WILL IT BE CUT TO SIZE?  ";:
      INVERSE :
      PRINT "Y/N":
      NORMAL
12200 ON F% = 0 GOTO 12400:
      VTAB 11:
      HTAB 30:
      PRINT T(2):
      VTAB 13:
      HTAB 30:
      PRINT T(3):
      VTAB 16:
      HTAB 30:
      PRINT ABS(T(4)):
      VTAB 19:
      HTAB 30:
      PRINT MID$("NY",(T(4) < 0) + 1,1):
      T(4) = ABS(T(4)):
      GOSUB 3300:
      F% = 0
12300 VTAB 7:
      HTAB 30:
      R = T(1):
      GOSUB 1300:
      IF T(1) < > R THEN
         A = R:
         PRINT X$:
         GOSUB 5980
12400 VTAB 11:
      HTAB 30:
      R = T(2):
      GOSUB 1400:
      IF T(2) < > R THEN
         T(2) = R:
         PRINT X$
```

```
12500 VTAB 13:
      HTAB 30:
      R = T(3):
      GOSUB 1400:
      IF T(3) <  > R THEN
         T(3) = R:
         PRINT X$
12600 VTAB 16:
      HTAB 30:
      R = T(4):
      GOSUB 1300:
      IF T(4) <  > R THEN
         T(4) = R:
         PRINT X$
12700 VTAB 19:
      HTAB 26:
      GOSUB 3000:
      HTAB 30:
      PRINT MID$("NY",(R$ = "Y") + 1,1):
      C$ = R$
12800 GOSUB 2900:
      IF R$ = "Y" THEN
         POKE 32,29:
         POKE 33,10:
         POKE 34,4:
         HOME :
         POKE 32,0:
         POKE 33,40:
         POKE 34,3:
         GOSUB 3300:
         GOTO 12300
12900 A = T(1):
      RD = T(2):
      LS = T(3):
      CS = T(4):
      IF C$ = "Y" THEN
         CS =  - CS
13000 ZL = 1:
      GOTO 14000

                              +-----------------------+
13050                         !  SLEEVE FILE ON DISK  !
                              +-----------------------+

13100 ON F$ <  > "" GOTO 13400:
      VTAB 10:
      INVERSE :
      PRINT "NAME OF DISK FILE: ";:
      NORMAL :
      PRINT " ";:
      N% = 0:
      GOSUB 1400:
      ON Q$ = "" GOTO 10600:
      F$ = Q$
```

```
13400 ONERR GOTO 23700
13500 PRINT D$"VERIFY "F$",D"DD:
      ONERR GOTO 23300
13600 PRINT D$"OPEN "F$",L25":
      PRINT D$"READ "F$",RO":
      INPUT A$:
      PRINT D$:
      ZL = VAL(A$)
13610 VTAB 14:
      CALL  - 958:
      PRINT "DO YOU WANT TO SEE A LIST":
      PRINT :
      PRINT "OF POSSIBLY USABLE SLEEVES? ";:
      GOSUB 3000:
      IF R$ <  > "Y" GOTO 13800
13612 X = A:
      A = .6:
      G = .8:
      T = 1:
      PRINT :
      PRINT :
      HTAB 5:
      INVERSE :
      PRINT " SETTING SEARCH LIMITS ";:
      NORMAL :
      GOSUB 5910:
      D = RD:
      T = 0:
      A = X
                        +---------------------------------+
13615                   ! SEARCH FILE FOR USABLE SLEEVES !
                        +---------------------------------+
13620 HOME :
      HTAB 35:
      PRINT "TO BE":
      PRINT "DIAMETER   LENGTH   ASAF    COST  CUT?":
      PRINT "--------   ------   ----   -----  -----":
      PRINT "  ("U1$")      ("U1$")":
      POKE 34,7:
      VTAB 7
13625 FOR M = 1 TO ZL:
         GOSUB 4600:
         C$ = "N":
         IF CS < 0 THEN
            C$ = "Y":
            CS =  - CS
13630    ON RD = 0 GOTO 13660:
         ON RD < 6 * A * MC OR RD > D GOTO 13660:
         C% = 2:
         L% = 7:
         R = RD:
         GOSUB 4200:
```

```
         C% = 1:
         L% = 9:
         R = LS:
         GOSUB 4200:
         C% = 2:
         L% = 8:
         R = A:
         GOSUB 4200:
         L% = 8:
         R = CS:
         GOSUB 4200:
         PRINT "   "Cs
13640    ON PEEK(37) < 20 GOTO 13660:
         VTAB 23:
         HTAB 3:
         INVERSE :
         PRINT " PRESS <S> TO STOP THE LISTING,  ":
         GOSUB 3900:
         IF R$ = "S" OR R$ = "s" THEN
            M = ZL + 1:
            POKE 34,3
13650    HOME
13660 NEXT :
      ON M = ZL + 2 GOTO 13610:
      POKE 34,3:
      PRINT :
      PRINT "  END OF SLEEVE FILE. SLEEVES OF MEDIAN   DIAMETER ARE MOST LIKELY
      TO BE USEFUL.":
      GOSUB 3900
                          +------------------------------+
13750                     !  SEARCH FOR SLEEVE DIAMETER  !
                          +------------------------------+
13800 GOSUB 2700:
      VTAB 15:
      PRINT "STOCK SLEEVE DIAMETER ("U1$")? ";:
      R = 0:
      M = 0:
      GOSUB 1300:
      D = R:
      PRINT
13900 M = M + 1:
      GOSUB 4600:
      IF D <  > RD GOTO 14600
14000 M = ZL + 1:
      IF RD <  = 4.4 * A * MC THEN
         Q$ = "LARGE":
         GOSUB 5140:
         GOTO 14600
14100 T = 0:
      R% = 0:
      Z$ = "DIAMETER":
      Q$ = "":
```

```
      GOSUB 5810:
      IF LEN(Q$) GOTO 14600
14300 GOSUB 5100:
      R$ = "STOCK":
      GOSUB 6700:
      GOSUB 6950:
      Z$ = "HEIGHT ":
      GOSUB 6110
14400 GOSUB 2700:
      VTAB 8:
      PRINT "DO YOU WANT A RISER NECK? ";:
      GOSUB 3000:
      IF R$ = "Y" THEN
         P = 1:
         GOTO 21000
14500 VTAB 10:
      HTAB 1:
      CALL  - 958:
      PRINT "SEND RISER ANALYSIS TO PRINTER? ";:
      GOSUB 3000:
      IF R$ = "Y" THEN
         P = 1:
         GOTO 18400
14600 ON M < ZL GOTO 13900:
      PRINT D$"CLOSE":
      IF M = ZL THEN
         VTAB 19:
         INVERSE :
         CALL 778:
         PRINT "END OF DISK FILE: DIAMETER NOT FOUND!":
         NORMAL :
         GOSUB 3900
14700 GOTO 10600

                              +----------------------+
15300                         !  UN-SLEEVED RISERS   !
                              +----------------------+

15400 F% = 0:
      P = 0:
      T = 0:
      GOSUB 2700:
      VTAB 6:
      PRINT "  1. RISER WITH FIXED DIAMETER":
      PRINT :
      PRINT "  2. RISER WITH FIXED HEIGHT":
      PRINT :
      PRINT "  3. RISER WITH FIXED HT/DIAM RATIO":
      PRINT :
      PRINT "  4. SET RISER NECK":
      PRINT
15500 PRINT "  5. ";:
      INVERSE :
      PRINT "PRINT";:
```

```
      NORMAL :
      PRINT " LAST RISER ANALYSIS":
      PRINT :
      PRINT "  6. RETURN TO RISER TYPE MENU":
      PRINT :
      PRINT "  7. RETURN TO MAIN MENU":
      PRINT :
      PRINT :
      ND = ND + RD * (NOT ND):
      L% = 7:
      GOSUB 3500
15700 ON R% GOTO 15800,16100,17000,18100,18100,10600,21700
                                  +-----------------+
15750                             !  FIXED DIAMETER !
                                  +-----------------+
15800 VTAB 23:
      HTAB 1:
      CALL  - 958:
      Q$ = "REQUIRED DIAMETER (" + U1$ + "): ":
      R = 0:
      GOSUB 1200:
      RD = R:
      R$ = "FIXED":
      PRINT :
      IF RD < 4.4 * A * MC THEN
         Q$ = "LARGE":
         GOSUB 5140:
         GOTO 15400
15900 Z$ = "DIAMETER":
      Q$ = "":
      GOSUB 5810:
      ON LEN(Q$) GOTO 15400:
      GOSUB 5100:
      GOSUB 6700:
      GOSUB 7000:
      Z$ = "HEIGHT ":
      GOSUB 6110:
      GOTO 15400
                                  +-----------------+
16050                             !  FIXED HEIGHT  !
                                  +-----------------+
16100 VTAB 23:
      HTAB 1:
      CALL  - 958:
      Q$ = "REQUIRED HEIGHT (" + U1$ + "): ":
      R = 0:
      GOSUB 1200:
      RH = R:
      H = RH:
      PRINT :
      Z$ = "HEIGHT":
      GOSUB 5160:
```

```
      IF RT = 1 OR RT = 2 OR RT = 5 THEN
         H = RH - .1 * RH * (RT = 1 OR RT = 5) - TI * (RT = 2)
16200 Q$ = "":
      GOSUB 5910:
      IF LEN(Q$) GOTO 15400
16500 GOSUB 5100:
      GOSUB 6400:
      GOSUB 6700:
      VTAB 12:
      PRINT A$"DIAMETER ("U1$"): ";FN P1(RD):
      VTAB 13:
      INVERSE :
      PRINT "FIXED";:
      NORMAL :
      PRINT "   HEIGHT  ("U1$"): ";RH
16600 VTAB 13:
      HTAB 29:
      PRINT "HT/DIAM= ";FN P1(H / RD):
      VTAB 16:
      PRINT "SECTION YIELD:  "YD" %"
16700 IF RT = 2 THEN
         VTAB 18:
         PRINT "TOP INSULATION: ";:
         INVERSE :
         PRINT FN P3(WI)S$U2$:
         NORMAL
16800 IF RT = 1 OR RT = 5 THEN
         VTAB 18:
         PRINT "  HOT TOPPING:  ";:
         INVERSE :
         PRINT FN P2(TW)S$U2$:
         NORMAL
16900 Z$ = "DIAMETER":
      GOSUB 6110:
      GOTO 15400
                              +------------------------+
16950                         !  FIXED HT/DIAM RATIO   !
                              +------------------------+
17000 T = 1:
      VTAB 23:
      HTAB 1:
      CALL  - 958:
      Q$ = "REQUIRED HEIGHT/DIAMETER RATIO: ":
      R = 0:
      GOSUB 1200:
      G = R:
      PRINT :
      Z$ = "HT/DIAM":
      GOSUB 5160:
      GOSUB 5910:
      RH = H + .1 * RD * (RT = 1 OR RT = 5) + TI * (RT = 2)
17100 GOSUB 6400:
```

```
      GOSUB 6700:
      VTAB 11:
      INVERSE :
      PRINT "HEIGHT/DIAMETER :";:
      NORMAL :
      PRINT " ";G:
      VTAB 13:
      PRINT A$"DIAM ("U1$"): ";FN P1(RD):
      VTAB 14:
      PRINT A$" HT  ("U1$"): ";FN P1(RH):
      VTAB 16:
      PRINT "SECTION YIELD(%): ";YD
17200 IF RT = 2 THEN
         VTAB 18:
         PRINT "TOP INSULTN ("U2$"): "FN P3(WI)
17300 IF RT = 1 OR RT = 5 THEN
         VTAB 18:
         PRINT "HOT TOPPING ("U2$"): "FN P3(TW)
17400 Z$ = "DIAMETER":
      GOSUB 6110:
      GOTO 15400
                                          +--+
18000                                     !  !
                                          +--+
18100 IF NOT RD THEN
         INVERSE :
         VTAB 23:
         CALL  - 958:
         CALL 778:
         PRINT "NO RISER ANALYSIS YET. CHOOSE AGAIN...";:
         NORMAL :
         GOSUB 3600:
         GOTO 15700
18200 IF R% = 4 GOTO 21000
                              +-------------------------+
18300                         !  PRINT RISER ANALYSIS   !
                              +-------------------------+
18400 GOSUB 2700:
      VTAB 10:
      R$ = STR$(RN):
      ON RN < 10 GOTO 18900:
      INVERSE :
      PRINT "RISER NUMBER (0-9): ";:
      NORMAL :
      PRINT " ";
18600 GET R$:
      R = ASC(R$):
      ON R = 13 GOTO 20700:
      IF R < 48 OR R > 57 THEN
         CALL 778:
         GOTO 18600
18800 PRINT R$
```

```
18900 RN = VAL(R$)
19000 PRINT D$"PR#"P%:
      L% = 8:
      PRINT P$(0)P$(2):
      PRINT :
      PRINT :
      PRINT :
      HTAB 23:
      PRINT "SECTION SUMMARY FOR RISER # "R$:
      HTAB 23:
      PRINT "============================":
      PRINT
19100 PRINT :
      PRINT "  BY:  ";LEFT$(UN$,29);TAB( 39)"FOR:  ";LEFT$(CN$,40):
      PRINT "DATE:  ";DT$;TAB( 45);LEFT$(CA$,40):
      PRINT SPC( 44);LEFT$(CC$,40):
      PRINT "   PURCHASE ORDER #:  "PO$:
      PRINT "CASTING DESCRIPTION:  "LEFT$(CD$,57):
      PRINT
19150 IF LEN(CD$) > 57 THEN
         PRINT TAB( 23);MID$(CD$,58,57)
19200 PRINT :
      PRINT "USING LOW ALLOY OR CARBON STEEL AT A POURING TEMPERATURE OF  "PT;5$
      U5$:
      PRINT :
      PRINT "   MOLDING MATERIAL:  ";MM$:
      PRINT :
      PRINT :
      PRINT :
      PRINT :
      PRINT
19300 PRINT "       SUB      WEIGHT    VOLUME      AREA      MODULUS      #
        CHILL":
      PRINT "     SECTION     ("U2$")     ("U4$")    ("U3$")     ("U1$")      CH
      ILLS    AREA"
19400 PRINT "     -------    ------    -------    -------    -------    ------
        -----":
      PRINT :
      FOR J = 0 TO 9:
         IF NOT VC(J) GOTO 19700
19500    HTAB 9:
         PRINT J"    ";:
         R = VC(J) * DF:
         C% = 1:
         GOSUB 4200:
         PRINT "   ";:
         R = VC(J):
         GOSUB 4200:
         PRINT "   ";
19600    R = SC(J):
         GOSUB 4200:
         PRINT "  ";:
```

```
        R = VC(J) / SC(J):
        GOSUB 4200:
        PRINT " ";:
        R = CN(J):
        GOSUB 4100:
        PRINT "   ";:
        R = AC(J):
        GOSUB 4200:
        PRINT
19700 NEXT :
      HTAB 17:
      PRINT "------    -------    -------    =======    ------    -----":
      HTAB 8:
      PRINT "SUMS: ";:
      R = VC * DF:
      GOSUB 4200:
      PRINT "   ";:
      R = VC:
      GOSUB 4200:
      PRINT "   ";:
      R = SC:
      GOSUB 4200:
      PRINT "  ";
19800 R = VC / SC:
      GOSUB 4200:
      PRINT " ";:
      R = CN:
      GOSUB 4100:
      PRINT "   ";:
      R = AC:
      GOSUB 4200:
      PRINT :
      PRINT :
      PRINT :
      PRINT
19900 PRINT "   RISER TYPE: "MS(RT);:
      IF NL THEN
         PRINT "/NECK";
20000 PRINT :
      PRINT :
      PRINT
20100 GOSUB 6400:
      HTAB 15:
      PRINT "APPARENT SURFACE ALTERATION FACTOR,  TOP: ";B:
      PRINT SPC( 50)"SIDE: ";A:
      PRINT :
      PRINT :
      PRINT "   RISER HEIGHT/DIAMETER:  ";FN P2(G);TAB( 50)"RISER WEIGHT  ("U2$"
      ):  ";FN P1(VR * DF)
20200 HTAB 5:
      PRINT "DIAMETER ("U1$"):  ";FN P1(RD):
      HTAB 5:
```

```
      PRINT "RISER   HEIGHT  ("U1$"):  ";FN P1(RH);TAB( 50);"SECTION YIELD  (%):
        ";YD
20250 IF RT < 5 THEN
         PRINT "SLEEVE LENGTH  ("U1$"):  ";FN P1(LS * (CS > 0) + RH * (CS < 0))
20300 IF (NA) THEN
         PRINT :
         PRINT "     NECK  DIMENSIONS ("U1$"):  ";FN P1(NA);"  BY  ";FN P1(NB):
         PRINT "     NECK   LENGTH  ("U1$"):  ";FN P1(NL):
         PRINT "     NECK  WEIGHT   ("U2$"):  ";FN P1(NL * NS * DF)
20400 PRINT :
      PRINT :
      IF RT = 2 THEN
         HTAB 23:
         PRINT "TOP INSULATION WEIGHT ("U2$"):  ";FN P2(WI):
         PRINT
20500 IF RT = 1 OR RT = 5 THEN
         HTAB 23:
         PRINT "HOT TOPPING WEIGHT ("U2$"):  ";FN P2(TW)
20600 PRINT :
      PRINT :
      IF RT = 4 OR RT = 7 THEN
         CALL 778:
         PRINT M$(8)
20700 PRINT D$"PR#0":
      ON P > 0 GOTO 14600:
      GOTO 15400

                                +------------------+
20900                           !  SET RISER NECK  !
                                +------------------+

21000 GOSUB 2700:
      PRINT :
      HTAB 9:
      PRINT "SIDE NECK DESIGN"
21050 NL = .3 * RD:
      VTAB 12:
      INVERSE :
      PRINT "NECK LENGTH ("U1$"): ";:
      NORMAL :
      PRINT S$;FN P1(NL)
21060 VTAB 15:
      INVERSE :
      PRINT "NECK DIMENSION("U1$"):";:
      NORMAL :
      PRINT S$;:
      R = 0:
      GOSUB 1300:
      NA = R:
      PRINT :
      VTAB 18:
      PRINT SPC( 39)""
21070 PRINT :
      NB = 1 / (1 / (2.2 * M(II,NN + 1)) - 1 / NA):
```

```
      ON NB > 0 GOTO 21080:
      VTAB 18:
      PRINT "DIMENSION TOO SMALL, ENTER NEW VALUE":
      GOTO 21060
21080 PRINT :
      VTAB 18:
      INVERSE :
      PRINT "NECK SIZE("U1$"):";:
      NORMAL :
      PRINT S$;FN P1(NA);"  BY  ";FN P1(NB):
      GOTO 21300
21100 VTAB 12:
      HTAB 20:
      R = NL:
      GOSUB 1300:
      IF R <  > NL THEN
         NL = R:
         PRINT X$
21200 VTAB 15:
      HTAB 21:
      R = NA:
      GOSUB 1300:
      IF NA <  > R THEN
         NA = R:
         PRINT X$:
         GOTO 21070
21300 GOSUB 2900:
      IF R$ = "Y" THEN
         GOSUB 3300:
         GOTO 21100
21400 NS = NA * NB:
      ON P > 0 GOTO 14500:
      GOTO 15400

                              +----------------------+
21600                         !  EXIT TO MAIN MENU   !
                              +----------------------+

21700 SA = A:
      P = 0:
      GOSUB 2700:
      VTAB 10:
      PRINT "HOW MANY IDENTICAL RISERS ARE THERE":
      PRINT :
      PRINT "     WITH THIS DESIGN/SIZE?   1"CHR$(8);:
      R = 1
21800 GOSUB 1300:
      NR = R:
      IF R = 0 THEN
         CALL 778:
         PRINT CHR$(8);:
         GOTO 21800
21850 IF NA = 0 THEN
         NS = PI * RD * RD / 4
```

```
21900 IF CS < 0 THEN
         CS =  - CS * RH / LS
                              +---------------------------+
22100                         !  RETURN TO MAIN PROGRAM   !
                              +---------------------------+
22200 POKE 34,0:
      HOME :
      VTAB 10:
      HTAB 10:
      INVERSE :
      PRINT " PLEASE WAIT WHILE ":
      HTAB 10:
      PRINT " PROGRAM IS LOADED ":
      NORMAL :
      SH = SH * 100
22300 R$ = CHR$(13):
      PRINT D$"OPEN SCRATCH1.V222":
      PRINT D$"WRITE SCRATCH1":
      PRINT CA$R$CC$R$CD$R$CN$R$DT$R$PO$R$UN$R$MM$R$A$C(P$(0))R$;:
      FOR I = 1 TO 8:
         PRINT M$(I)R$A$C(P$(I))R$;:
      NEXT
22400 PRINT CI","CS","DD","DI","FF","MP","MW","NL","NS","P%","PT","RD","RH","RT"
      ,"SA","SH","TD","TI","TW","VR","XM
22500 PRINT CHR$(4)"OPEN SCRATCH2.V222":
      PRINT D$"WRITE SCRATCH2":
      PRINT U0$","U1$","U2$","U3$","U4$","U5$","U6$","AC","AN","CN","DF","IC","I
      W","LS","MM","N","NC","NN","NR","NV","RN","RV","SC","SL","SN","SP","SR","S
      S","VC","VN","WT
22600 FOR I = 0 TO 9:
         PRINT AC(I)","CN(I)","SC(I)","VC(I):
      NEXT :
      FOR I = 0 TO 9:
         FOR J = 0 TO 9:
            PRINT AJ(I,J):
         NEXT :
      NEXT :
      PRINT CHR$(4)"CLOSE"
22700 POKE 104,8:
      POKE 2048,0:
      PRINT D$"RUN CANMET MAIN PROGRAM.D1"
                              +---------------------------+
22800                         !  ERROR HANDLER & EXIT     !
                              +---------------------------+
22900 R = PEEK(222):
      CALL 778:
      IF R = 8 THEN
         INVERSE :
         PRINT "CANNOT READ DISK DRIVE. PLEASE CHECK...":
         NORMAL :
         GOSUB 3900:
         GOTO 10600
```

```
23200 IF R = 11 THEN
        INVERSE :
        PRINT "BAD FILE NAME.";:
        NORMAL :
        PRINT " TRY AGAIN..."X$:
        GOSUB 3900:
        GOTO 11900
23300 HOME :
      VTAB 6:
      PRINT "EXIT ON ERROR NUMBER ";PEEK(222):
      VTAB 8:
      PRINT "AT LINE NUMBER ";PEEK(218) + 256 * PEEK(219)
23400 VTAB 11:
      PRINT :
      PRINT "TO RESUME WITH THE SAME DATA, TYPE:":
      HTAB 27:
      INVERSE :
      PRINT " GOTO 10 ":
      NORMAL :
      PRINT :
      PRINT "TO RUN A NEW CASTING, TYPE:"
23500 POKE 34,0:
      HTAB 27:
      INVERSE :
      PRINT " RUN HELLO ":
      NORMAL :
      PRINT :
      END

                                        +--+
23600                                   !  !
                                        +--+

23700 ON PEEK(222) = 6 GOTO 24000:
      ONERR GOTO 23300
23900 GOTO 22900
24000 HTAB 1:
      CALL  - 958:
      CALL 778:
      PRINT "FILE NOT FOUND.  TRY AGAIN":
      CALL 778:
      F$ = "":
      GOSUB 3900:
      GOTO 11900

                      +------------------------------+
63998                 !                              !
63998                 ! 11 APR 1984                  !
63998                 !                              !
64000                 ! M.R. VINER/ K.G. DAVIS       !
64000                 ! METALLURGICAL ENGINEERING    !
64000                 ! QUEEN'S UNIV. AT KINGSTON    !
64000                 !          &                   !
64000                 ! PHYS. MET. RES. LAB., OTTAWA !
                      +------------------------------+
```

VARIABLE CROSS REFERENCE:

A 4600 5225 5230 5810 5910 5980 6700 10560 11200 11300 11400 11900
12000 12100 12300 12900 13612 13630 14000 15800 20100 21700
A$ 4600 10700 11200 11300 11400 13600 16500 17100
A(5340 5345 5385 10425 10480
AC 10400 19800 22500
AC(10450 19600 22600
AJ(10450 10480 22600
AN 10400 22500
B 5225 5810 5910 6700 10800 11000 11100 11200 11300 11400 11600 20100
C 5490 6140 6150 6170 6190
C$ 12700 12900 13625 13630
C% 780 4200 4300 4400 6130 6140 13630 19500
C(5420 5460 5490 5570 6170 10425
CA$ 10200 19100 22300
CC$ 10200 19100 22300
CD$ 10200 19100 19150 22300
CI 10350 11700 22400
CN 10400 19800 22500
CN$ 10200 19100 22300
CN(10450 19600 22600
CS 4600 6950 10350 10560 12900 13625 13630 20250 21900 22400
D 13612 13630 13800 13900
D$ 4600 10000 10200 10400 10450 13500 13600 14600 19000 20700 22300 22500
22700
DD 10350 13500 22400
DF 10400 19500 19700 20100 20300 22500
DI 6400 10350 22400
DT 5225 10400
DT$ 10200 19100 22300
E 5810 5815 5820 5910 5915 5920
F 5460 5490 5540 6160
F$ 4600 10550 13100 13500 13600 24000
F% 10560 11900 12000 12200 15400
FF 10350 22400
G 5100 5110 5170 5215 5220 5225 5980 13612 17000 17100 20100
H 5215 5220 5225 5460 5490 5570 5810 5815 5820 5830 5835 5840
5860 5915 5920 5940 6140 6150 6220 6230 6400 7100 10560 16100
16600 17000
HH 5225 5570
I 780 5205 5230 5270 5280 5300 5340 5345 5355 5385 5390 5420
5460 5490 6170 6180 10300 10450 10460 10500 10600 22300 22600
IC 10400 22500
II 5225 5230 5300 5600 10455 21070
IW 10400 22500
J 5205 5270 5355 5385 5420 6160 6170 6180 10450 10460 10470 10480
19400 19500 19600 22600
K 5390 5420 5460 5490 5540 6160 10480
L 780 1500 5270 5285 5300 5340 5345 5355 5385 5490 6170
L% 1400 1900 2000 2300 3600 4100 4400 10600 13630 15500 19000
LS 4600 4700 4800 5145 6950 10400 10560 12900 13630 20250 21900 22500

M	4600	13625	13640	13660	13800	13900	14000	14600				
MS(	2700	6700	10300	10600	19900	20600	22300					
M(	5205	5230	5270	5300	5355	5385	5420	10425	21070			
MC	5810	5910	10455	10500	13630	14000	15800					
MM	10400	22500										
MMS	10300	19200	22300									
MP	10350	10400	22400									
MR	5225	5270										
MW	5460	10350	22400									
N	5500	5520	5540	5570	10400	22500						
N%	1300	1500	2300	13100								
NA	20300	21060	21070	21080	21200	21400	21850					
NB	20300	21070	21080	21400								
NC	10400	22500										
ND	6400	15500										
NL	6400	10350	19900	20300	21050	21100	22400					
NN	5205	5230	5270	5300	5340	5355	5385	5390	5420	5430	5500	5600
	5815	5840	5915	5940	6160	6180	6205	10400	10455	21070	22500	
NR	10400	21800	22500									
NS	10350	20300	21400	21850	22400							
NV	10400	22500										
P	5490	5540	5570	6160	6170	10500	14400	14500	15400	20700	21400	21700
PS(	10300	19000	22300									
P%	10000	10350	19000	22400								
P1(	5145	5980	6130	6140	6950	7000	7100	10000	16500	16600	17100	20100
	20200	20250	20300	21050	21080							
P2(	4700	4800	7200	10000	16800	20100	20400	20500				
P3(	7150	10000	16700	17200	17300							
PI	5225	5460	6400	6500	10000	21850						
POS	10300	19100	22300									
PT	10350	10400	19200	22400								
Q	5270	5280	5285	5300	5340	5345	5355	6160	6170			
QS	1200	1400	1900	2000	2300	4200	4400	5110	5120	5140	5820	5920
	10300	13100	14000	14100	15800	15900	16100	16200	17000			
R	2300	4100	4200	5215	5225	5230	5270	5460	5620	5630	5810	5820
	5910	5915	5920	5930	5935	5960	6150	6160	6220	6230	10000	11600
	11700	11800	12100	12300	12400	12500	12600	13630	13800	15800	16100	17000
	18600	19500	19600	19700	19800	21060	21100	21200	21700	21800	22900	23200
RS	500	1500	1900	2000	3000	3600	3700	4200	4300	4400	4600	4700
	4800	5120	5610	5620	6120	6210	7000	10550	11900	12700	12800	13610
	13640	14300	14400	14500	15800	18400	18600	18800	18900	19000	21300	22300
R%	780	3600	4300	4400	5130	5170	6130	6140	10560	10600	10700	14100
	15700	18200										
RD	4600	4700	4800	5130	5140	5145	5170	5215	5220	5230	5570	5810
	5860	5940	5980	6130	6140	6220	6230	6500	7000	7100	10350	10560
	12900	13612	13630	13900	14000	15500	15800	16500	16600	17000	17100	18100
	20200	21050	21850	22400								
RF	5225	5490	5570	6170								
RH	5145	5170	5860	6140	6220	6230	6950	7100	10350	10560	16100	16500
	17000	17100	20200	20250	21900	22400						
RN	10400	18400	18900	22500								
RT	2700	5630	5860	6110	6220	6230	6400	6500	6700	7150	7200	10350

```
      10550 10560 10600 16100 16700 16800 17000 17200 17300 19900 20250 20400
      20500 20600 22400
RV    10400 22500
S      5810  5815  5820  5830  5835  5840  5910  5915  5920  5930  5935  5940
       6160  6170
S$     1200  2300  5145  5170  5980  6130  6140  6220  7150  7200 10000 16700
      16800 19200 21050 21060 21080
S(     5225  5230  5285 10425 10455 10460 10470
SA    10350 10560 21700 22400
SC    10400 19700 19800 22500
SC(   10450 10455 10460 10470 10500 19600 22600
SH     5460  5490  5540  6160 10350 22200 22400
SL    10400 22500
SN    10400 22500
SP    10400 22500
SR     5610  5620  5630 10400 10455 10460 10470 10500 22500
SS    10400 22500
SS(    5205  5270  5300  5355 10425
T      5215  5920  5980 13612 14100 15400 17000
T(     5270  5280  5355  5980 10460 10470 10480 10560 11900 12000 12100 12200
      12300 12400 12500 12600 12900
TD     6500 10350 22400
TI     5860  6220  6230  6400 10350 10560 11800 16100 17000 22400
TW     6500  7200 10350 16800 17300 20500 22400
U      5270  5355  5460
U0$    4700  4800 10400 22500
U1$    5145  5980  6130  6140  6220  6950  7000  7100 10400 11800 12150 13620
      13800 15800 16100 16500 17100 19300 20200 20250 20300 21050 21060 21080
      22500
U2$    7150  7200 10400 11700 16700 16800 17200 17300 19300 20100 20300 20400
      20500 22500
U3$   10400 19300 22500
U4$   10400 19300 22500
U5$   10400 19200 22500
U6$   10400 22500
UN$   10300 19100 22300
V      5460  6180
V(     5230  5270  5285  5355  5385  5420 10425 10455 10460 10470
VC     5225  5460  6400 10400 19700 19800 22500
VC(    5620 10450 10455 10460 10470 10480 10500 19400 19500 19600 22600
VN    10400 22500
VR     5225  5460  6400 10350 20100 22400
W      5285  5300  5340  5490  6170
WI     6400  7150 16700 17200 20400
WT    10400 22500
X      5570  6160  6170  6190 13612
X$     4100  4400  6130  6140  6950  7000  7100 10000 12100 12300 12400 12500
      12600 21100 21200 23200
X(     5205  5270  5355  5390  5420  5460  5490  5520  5570  5815  5840  5915
       5940  6160  6170  6205 10425
XM     5230 10350 22400
Y      5570  5815  5840  5915  5940  6170  6180  6190
```

```
  Y$      780  6130  6140
  Y(     5205  5490  5570  6170 10425
  Y1     5570  6205
  YD     6400  7100 16600 17100 20200
  Z       780  5225  5230  5390  5420  5460  5490  6170
  Z$     5170  6210  6220 14100 14300 15900 16100 16900 17000 17400
  Z(     5230  5285  5385 10425
  ZL    13000 13600 13625 13640 13660 14000 14600
```

NOTES:

```
 * INDICATES SYMBOL REFERENCED AT ONE LINE NUMBER ONLY.
** INDICATES SYMBOL EQUIVALENT TO PREVIOUSLY DEFINED SYMBOL.
-> INDICATES UNDEFINED SYMBOL.

LINE NUMBER 99999 ==> TOO MANY REFERENCES TO THE VARIABLE:
                      LATER REFERENCES ARE NOT LISTED.
```

```
                          +--------------------------+
 10                       ! ************************ !
 10                       ! *  CANMET RISERING 2.1  * !
 10                       ! *                      * !
 10                       ! *     INSTRUCTIONS     * !
 10                       ! ************************ !
                          +--------------------------+
100 POKE 51,128:
    IF PEEK(780) + PEEK(781) <  > 140 THEN
       PRINT CHR$(4)"BLOAD CANMET SUPPORT":
       VTAB 23:
       HTAB 1:
       INVERSE :
       PRINT "PRESS SPACE BAR TO CONTINUE";:
       NORMAL :
       PRINT " ";:
       GET R$
150 GOSUB 400:
    INVERSE :
    VTAB 23:
    HTAB 2:
    PRINT "C";:
    NORMAL :
    PRINT "-NEXT PARAGRAPH   ";:
    INVERSE :
    PRINT "F";:
    NORMAL :
    PRINT "-SKIP TO NEXT PAGE"
200 HTAB 2:
    INVERSE :
    PRINT "Q";:
    NORMAL :
    PRINT "-QUIT PROGRAM     ";:
    INVERSE :
    PRINT "B";:
    NORMAL :
    PRINT "-SEE PREVIOUS PAGE";:
    POKE 34,2:
    POKE 35,21:
    GOTO 1500
                          +------------------------+
300                       ! **** SUBROUTINES **** !
                          +------------------------+
400 POKE 34,0:
    HOME :
    HTAB 5:
    INVERSE :
    PRINT " CANMET RISERING: INSTRUCTIONS ":
    NORMAL :
    RETURN
                                    +---+
500                                 !   !
```

```
                                                +---+
 600 GET R$:
     IF R$ = CHR$(16) THEN
        CALL 800:
        GOTO 600
 650 IF R$ = "Q" OR R$ = "q" GOTO 1200
 700 IF R$ = "b" THEN
        R$ = "B"
 800 IF R$ = "c" THEN
        R$ = "C"
 900 IF R$ = "f" THEN
        R$ = "F"
1000 IF R$ = "B" OR R$ = "C" OR R$ = "F" THEN
        RETURN
1100 CALL 778:
     GOTO 600
1200 POKE 35,24:
     HOME :
     VTAB 12:
     PRINT "   RUN THE RISERING PROGRAM NOW? ";:
     INVERSE :
     PRINT "Y/N";:
     NORMAL :
     PRINT " ";:
     GET R$:
     IF R$ = "Y" OR R$ = "y" THEN 1270
1210 PRINT :
     VTAB 12:
     PRINT "   TO RESUME INSTRUCTIONS, TYPE ";:
     INVERSE :
     PRINT " RUN ":
     NORMAL :
     POKE 34,0:
     END
1270 POKE 34,0:
     HOME :
     VTAB 10:
     HTAB 12:
     INVERSE :
     PRINT " PLEASE WAIT WHILE ":
     HTAB 12:
     PRINT " PROGRAM IS LOADED ":
     NORMAL :
     ONERR GOTO 1300
1290 PRINT CHR$(4)"VERIFY SCRATCH2.V222":
     POKE 216,0:
     PRINT CHR$(4)"RUN CANMET MAIN PROGRAM"
1300 POKE 216,0:
     PRINT CHR$(4)"RUN HELLO"
                              +-------------------------+
1400                          ! **** MAIN PROGRAM **** !
                              +-------------------------+
```

```
 1500 HOME :
      VTAB 5:
      PRINT "1. INSTRUCTIONS:":
      PRINT :
      PRINT "   A BRIEF SUMMARY OF EACH OPTION IN THEMAIN MENU, WITH A RECOMMEND
      ED ORDER OF  SELECTION. THIS IS FOLLOWED BY A SHORT  TUTORIAL ON THE METHO
      DOLOGY OF RISERING."
 1600 VTAB 14:
      PRINT "   YOU HAVE CONTROL OF THE TEXT DISPLAY BY MEANS OF THE  4  KEYSTRO
      KE COMMANDS  SHOWN AT THE BOTTOM OF THE SCREEN. ALL  OTHER KEYSTROKES EXCE
      PT ":;
      INVERSE :
      PRINT "RESET";:
      NORMAL :
      PRINT " WILL BE   IGNORED."
 1700 GOSUB 600:
      IF R$ = "B" THEN
         CALL 778:
         GOTO 1700
 1800 HOME :
      PRINT :
      PRINT "2. CUSTOMER/CASTING INFO:":
      PRINT :
      PRINT "   ALLOWS YOU TO ENTER YOUR NAME, THE   CUSTOMER NAME AND ADDRESS,
      THE PURCHASE ORDER NUMBER, AND THE CURRENT DATE.":
      PRINT :
      GOSUB 600:
      IF R$ = "F" GOTO 2200
 2000 ON R$ = "B" GOTO 1500:
      PRINT "   CASTING INFORMATION CONSISTS OF A    QUALITATIVE DESCRIPTION OF
      THE CASTING  AND THE  POURING TEMPERATURE, MELTING   POINT, DENSITY, AND S
      HRINKAGE OF THE    STEEL. AND THE DENSITY OF HOT TOPPING"
 2100 PRINT "AND TOP INSULATION (IF ANY).":
      PRINT :
      PRINT "   THE SHRINKAGE OF THE STEEL FOR A     GIVEN % CARBON AND POURING
      TEMPERATURE  IS SELECTED BY THE PROGRAM. BUT CAN BE  OVER-RIDDEN AT YOUR D
      ISCRETION.":
 2150 GOSUB 600:
      IF R$ = "B" GOTO 1500
 2200 HOME :
      PRINT :
      PRINT "2. CUSTOMER/CASTING INFO (PART 2):":
      PRINT :
      PRINT "   YOU CAN CHOOSE TO WORK IN IMPERIAL   OR METRIC UNITS,  AND TO SW
      ITCH UNITS   AT ANY TIME.  AFTER EACH 'PAGE' OF"
 2300 PRINT "INFORMATION, YOU ARE GIVEN A CHANCE TO  CHANGE ANY ITEMS ON THE PAG
      E.":
      PRINT :
      GOSUB 600:
      ON R$ = "F" GOTO 2700:
      ON R$ = "B" GOTO 1800:
      PRINT "   WHEN CHANGING ANY ITEM OF CUSTOMER/"
```

```
2500 PRINT "CASTING INFORMATION. PRESS THE <RETURN> KEY AT THE BEGINNING OF THE
     ENTRY FIELD TO LEAVE A LINE UNCHANGED. TYPING ANY   CHARACTERS BEFORE <RE
     TURN> WILL ERASE   THE PREVIOUS ENTRY.":
     GOSUB 600:
     IF R$ = "B" GOTO 1800
2700 HOME :
     PRINT :
     PRINT "2. CUSTOMER/CASTING INFO (PART 3):":
     PRINT :
     PRINT "   YOU CAN SELECT THE MOLDING MATERIAL  AND MOLDING PROCESS FROM ME
     NUS (WITH A  DEFAULT TO GREEN SILICA SAND).":
     PRINT
2800 PRINT "   YOUR CHOICE WILL AFFECT THE FEEDING  DISTANCE AND THE ALLOWANCE
     FOR MOLD WALLMOVEMENT IN RISER SIZE CALCULATIONS.":
     GOSUB 600:
     ON R$ = "F" GOTO 3100:
     IF R$ = "B" GOTO 2200
2900 PRINT :
     PRINT "   CUSTOMER/CASTING INFORMATION OR      SECTION/RISER DATA MAY BE L
     OADED FROM   A DISK FILE (PREVIOUSLY GENERATED       WITH OPTION 8).  AND
     MAY BE CHANGED     AT ANY TIME WITH OPTION 2."
3000 GOSUB 600:
     IF R$ = "B" GOTO 2200
3100 HOME :
     PRINT :
     PRINT "3. FEEDING DISTANCE:":
     PRINT :
     PRINT "   ALLOWS YOU TO ESTIMATE THE SOUND     FEEDING DISTANCE FROM THE R
     ISER FOR A   GIVEN CASTING SECTION, DEPENDING ON THE EFFECTIVE THICKNESS A
     ND WIDTH OF THE"
3200 PRINT "SECTION,  AND WHETHER CHILLS OR A TAPER (PADDING) ARE USED.":
     PRINT :
     GOSUB 600:
     ON R$ = "F" GOTO 3800:
     ON R$ = "B" GOTO 2700:
     PRINT "   THE SOUND FEEDING DISTANCES ARE"
3400 PRINT "GIVEN FROM THE EDGE OF THE RISER, FOR   WHICH A PRELIMINARY RADIUS
     IS ESTIMATED.IF A DRAG CHILL IS USED, THE FEEDING    DISTANCE IS TO THE ED
     GE OF THE CHILL.":
     GOSUB 600:
     ON R$ = "F" GOTO 3800:
     IF R$ = "B" GOTO 2700
3600 PRINT :
     PRINT "   YOU CAN ALSO ";:
     INVERSE :
     PRINT "PRINT";:
     NORMAL :
     PRINT " A TABLE OF ALL    FEEDING DISTANCES FOR EACH SPECIFIED    SECTION
     SIZE.";:
     GOSUB 600:
     IF R$ = "B" GOTO 2700
3800 HOME :
```

```
      PRINT :
      PRINT "4. CASTING SHAPE/SIZE:":
      PRINT :
      PRINT "   A SERIES OF OPTIONS BY WHICH YOU CAN DESCRIBE THE VOLUME AND SUR
      FACE AREA OF A CASTING SECTION TO BE FED BY A SINGLE RISER.":
      PRINT :
      GOSUB 600:
      IF R$ = "F" GOTO 4310
 4100 ON R$ = "B" GOTO 3100:
      PRINT "  YOU CAN DESCRIBE THE SECTION AS A     SUM OF ELEMENTARY SHAPES, W
      HICH ARE     SHOWN USING HI-RESOLUTION 3-D GRAPHICS. THESE SHAPES CAN BE U
      SED TO SPECIFY"
 4200 PRINT "VOIDS WITHIN THE CASTING, NON-COOLING   SURFACES AND CHILL AREAS AS
       WELL.":
      PRINT :
      GOSUB 600:
      ON R$ = "F" GOTO 4310:
      IF R$ = "B" GOTO 3100
 4300 PRINT "   SINCE A RISER MAY FEED SEVERAL        SECTIONS OF DIFFERING MODUL
      US, YOU MAY  LABEL AND SEPARATELY DESCRIBE THE SUB-  SECTIONS TO BE ADDED
      TOGETHER LATER.";:
      GOSUB 600:
      IF R$ = "B" GOTO 3100
 4310 HOME :
      PRINT :
      PRINT "4. CASTING SHAPE/SIZE (PART 2):":
      PRINT :
      PRINT "   COMPLEX CASTINGS WITH UNIFORM CROSS- SECTION MAY BE DESCRIBED WI
      TH THE HELP  OF AN APPLE GRAPHICS TABLET, IF ONE IS  AVAILABLE.":
      PRINT
 4315 GOSUB 600:
      ON R$ = "F" GOTO 4400:
      IF R$ = "B" GOTO 3800
 4320 PRINT "   THE ";:
      INVERSE :
      PRINT "QUICK-DRAW";:
      NORMAL :
      PRINT " UTILITY FOR THE TABLETIS INCLUDED ON THE CANMET MASTER DISK.  BUT
      THIS OPTION ALSO REQUIRES THAT YOU  HAVE PUT THE TEXT FILE ";
 4330 INVERSE :
      PRINT "TAB.INFORMATION":
      NORMAL :
      PRINT "(WITH CALIBRATION PARAMETERS FOR YOUR   TABLET) ON THE MASTER DISK.
      ":
      PRINT :
      GOSUB 600:
      ON R$ = "F" GOTO 4400:
      IF R$ = "B" GOTO 3800
 4340 PRINT "   YOU MUST DRAW THE CROSS-SECTIONAL    PROFILE OF THE CASTING IN O
      NE UNBROKEN  LINE. OPPORTUNITY IS PROVIDED TO REDRAW THE PROFILE IF NECESS
      ARY.";:
      GOSUB 600:
```

```
      IF R$ = "B" GOTO 3800
 4400 HOME :
      PRINT :
      PRINT "5. RISER SIZE/NECK:":
      PRINT :
      PRINT "  THIS OPTION CANNOT BE ENTERED UNTIL   THE ";:
      INVERSE :
      PRINT "CASTING SHAPE/SIZE";:
      NORMAL :
      PRINT " OPTION HAS BEEN  USED.  IF IT HAS, THE SUB-SECTIONS ARE"
 4500 PRINT "SUMMED, THE MODULUS OF EACH IS CALCULA- TED AND YOU ARE ASKED FOR T
      HE SUBSECTIONON WHICH THE RISER WILL BE PLACED.":
      PRINT :
      GOSUB 600:
      ON R$ = "F" GOTO 4900:
      IF R$ = "B" GOTO 4310
 4600 PRINT "   YOU MAY SPECIFY YOUR RISER TYPE FROM A MENU OF SEVEN CHOICES OF
      CYLINDRICAL  TOP RISERS.  IF YOU CHOOSE A SLEEVED"
 4700 PRINT "RISER,  YOU WILL BE ASKED IF YOU WANT   TO SELECT A SLEEVE FROM STO
      CK (VIA A    DATA FILE ON DISK).":
      GOSUB 600:
      IF R$ = "B" GOTO 4310
 4900 HOME :
      PRINT :
      PRINT "5. RISER SIZE/NECK (PART 2):":
      PRINT :
      PRINT "   THE DATA FILE OF RISER SLEEVES IS SETUP VIA A PROGRAM CALLED FRO
      M OPTION  8  BELOW.  EACH RECORD CONTAINS THE INNER  DIAMETER,  LENGTH,  A
      PPARENT SURFACE "
 5000 PRINT "ALTERATION FACTOR AND AN INDICATION OF  WHETHER THE SLEEVE WILL BE
      CUT TO SIZE.":
      GOSUB 600:
      ON R$ = "F" GOTO 5400:
      IF R$ = "B" GOTO 4400
 5100 PRINT :
      PRINT :
      PRINT "   YOU MAY SEARCH THE DISK FILE FOR A   PARTICULAR SLEEVE DIAMETER,
       OR SCAN THE FILE TO OBTAIN A LIST OF ALL POTENTIALLYUSABLE SLEEVES FOR TH
      E SECTION BEING    ANALYSED.":
      GOSUB 600:
      IF R$ = "B" GOTO 4400
 5400 HOME :
      PRINT :
      PRINT "5. RISER SIZE/NECK (PART 3):":
      PRINT :
      PRINT "   SLEEVES OF DIFFERING LENGTHS BUT     THE SAME DIAMETER ARE DISTI
      NGUISHED     BY DIFFERENCES IN THE SECOND DECIMAL"
 5410 PRINT "DIGIT OF THE RECORDED SLEEVE DIAMETER.":
      PRINT :
      GOSUB 600:
      ON R$ = "F" GOTO 5700:
      IF R$ = "B" GOTO 4900
```

```
5450 PRINT "   IF THE SLEEVE IS NOT TO BE SELECTED  FROM A DISK FILE, YOU WILL
     BE ASKED FOR THE DIAMETER,  LENGTH,  ASAF,  COST AND 'CUTTABILITY' OF THE
     SLEEVE TO BE USED.":
     PRINT :
     GOSUB 600:
     ON R$ = "F" GOTO 5700:
     IF R$ = "B" GOTO 4900
5500 PRINT "   YOU MUST SPECIFY ANY RESTRICTIONS ON THE HEIGHT OR DIAMETER OF A
      RISER WHICH DOES NOT HAVE AN INSULATING SLEEVE.      IF THERE ARE NO RESTR
     ICTIONS.  YOU MAY  SIMPLY SPECIFY THE HT/DIAM RATIO."
5600 GOSUB 600:
     IF R$ = "B" GOTO 4900
5700 HOME :
     PRINT :
     PRINT "5. RISER SIZE/NECK (PART 4)":
     PRINT :
     PRINT :
     PRINT "   ONCE A RISER IS SPECIFIED, A STANDARDFORMULA RISER NECK MAY BE C
     ALCULATED BY THE PROGRAM AND ALTERED TO YOUR SPECIFI-CATIONS.":
     PRINT
5750 GOSUB 600:
     ON R$ = "F" GOTO 5900:
     IF R$ = "B" GOTO 5400
5800 PRINT "   YOU MAY ALSO PRODUCE A PRINTOUT      SHOWING A DETAILED SUMMARY
     OF THE SUB-  SECTION AND RISER PARAMETERS FOR YOUR   PERMANENT FILES.":
     GOSUB 600:
     PRINT :
     IF R$ = "B" GOTO 5400
5900 HOME :
     PRINT :
     PRINT "6. GATING SYSTEM:":
     PRINT :
     PRINT "   THIS SECTION IS INTENDED TO HELP YOU DESIGN A GATING SYSTEM FOR
     THE CASTING, AND TO PROVIDE ADDITIONAL DATA FOR A    COMPLETE COST ANALYSI
     S.":
     PRINT
6000 GOSUB 600:
     ON R$ = "F" GOTO 6400:
     ON R$ = "B" GOTO 5700:
     PRINT
6200 PRINT "   YOU MUST TYPE IN THE RATIO OF NET    GATE AREA/SPRUE AREA,  SPRU
     E HEIGHT,    PATTERN HEIGHT AND DEPTH, TOTAL NUMBER  OF GATES, AND NUMBER
     OF GATES ATTACHED  TO THE CASTING. (SOME MAY BE ATTACHED   TO RISERS)":
     PRINT
6300 GOSUB 600:
     IF R$ = "B" GOTO 5700
6400 HOME :
     PRINT :
     PRINT "   GATING SYSTEM (PART 2):":
     PRINT :
     PRINT "   IF THE NET VOLUME AND AREA OF THE    CASTING HAVE NOT BEEN SUMME
     D,  THE      PROGRAM WILL ASK WHETHER ALL SECTIONS   HAVE BEEN RISERED."
```

```
6500 GOSUB 600:
     ON R$ = "F" GOTO 7100:
     IF R$ = "B" GOTO 5900
6700 PRINT :
     PRINT "   IF YOUR ANSWER IS YES, IT WILL READ  THE APPROPRIATE SECTION/RIS
     ER DATA FILESFROM DISK IN ORDER TO ADD UP THE NET    CASTING VOLUME AND OT
     HER PARAMETERS     NECESSARY FOR LATER COST ANALYSIS."
6800 GOSUB 600:
     ON R$ = "F" GOTO 7100:
     IF R$ = "B" GOTO 5900
6900 PRINT :
     PRINT "   THEN THE PROGRAM WILL ESTIMATE THE   REQUIRED POURING TIME AND T
     HE NET WEIGHTAND GATE AREA OF THE SYSTEM USING A     STANDARD FORMULA.  YO
     U MAY SUBSTITUTE   DIFFERENT VALUES AT YOUR DISCRETION.";
7000 GOSUB 600:
     PRINT :
     IF R$ = "B" GOTO 5900
7100 HOME :
     PRINT :
     PRINT "7. COST ANALYSIS:":
     PRINT :
     PRINT "   HERE YOU CAN ENTER PERTINENT COST    INFORMATION,  SUCH AS COST
     OF MOLTEN    METAL/UNIT WT, CUTOFF COSTS/UNIT AREA,  ETC.  OR LOAD THEM FR
     OM A PREVIOUSLY"
7200 PRINT "DEFINED DISK FILE.":
     PRINT :
     GOSUB 600:
     ON R$ = "F" GOTO 7600:
     IF R$ = "B" GOTO 6400
7400 PRINT "   IF YOU HAVE COMPLETED OPTIONS 4 AND  5 FOR A GIVEN RISERED SECTI
     ON, YOU CAN  PRODUCE A SCREEN DISPLAY OR A PRINTOUT  OF ITS COSTS.  A NET
     COST ANALYSIS FOR"
7500 PRINT "THE CASTING REQUIRES COMPLETION OF      OPTION 6 (GATING SYSTEM) AS
      WELL.":
     GOSUB 600:
     IF R$ = "B" GOTO 6400
7600 HOME :
     PRINT :
     PRINT "7. COST ANALYSIS (PART 2):":
     PRINT :
     PRINT
7650 PRINT "   IN ORDER TO COMPARE THE COST OF      DIFFERENT RISER DESIGNS, YO
     U NEED TO    RETURN TO OPTION 5 TO CHANGE THE RISER  TYPE/NECK PARAMETERS,
      THEN RE-ENTER THE COST ANALYSIS OPTION TO PRODUCE ANOTHER PRINTOUT."
7700 PRINT :
     PRINT :
     PRINT "   COMPARISON OF TWO DESIGNS CANNOT BE  PRESENTED ON THE SCREEN, BU
     T REQUIRES   TWO SEPARATE PRINTOUTS.":
     PRINT :
     GOSUB 600:
     IF R$ = "B" GOTO 7100
7800 HOME :
```

```
      PRINT :
      PRINT "8. QUIT/STORE FILES ON DISK:":
      PRINT :
      PRINT "   YOU CAN USE THIS OPTION TO STORE     ON THE DISK THE CUSTOMER/CA
      STING INFO   (WITH GATING SYSTEM PARAMETERS) OR THE  SECTION/RISER DATA (S
      UB-SECTION VOLUME"
 7900 PRINT "AND SURFACE AREAS, AND RISER/NECK DATA)":
      PRINT :
      GOSUB 600:
      ON R$ = "F" GOTO 8300:
      ON R$ = "B" GOTO 7600:
      PRINT :
      PRINT "   THE NAMES OF THESE FILES ARE ASSIGNEDBY THE PROGRAM, USING THE F
      IRST TWENTY"
 8100 PRINT "CHARACTERS OF THE PURCHASE ORDER # AS   PART OF THE FILE NAME IN OR
      DER TO AVOID ACCIDENTAL OVER-WRITING OF PREVIOUSLY   STORED DATA FROM OTHE
      R CASTINGS.":
      PRINT :
      GOSUB 600:
      IF R$ = "B" GOTO 7600
 8300 HOME :
      PRINT :
      PRINT "8. QUIT/STORE FILES ON DISK (PART 2):":
      PRINT :
      PRINT "   YOU CAN SAVE THE COST INFORMATION    ENTERED IN OPTION 7, USING
      A DISK FILE  NAME OF YOUR CHOICE.":
      PRINT :
      PRINT
 8310 GOSUB 600:
      ON R$ = "F" GOTO 8800:
      IF R$ = "B" GOTO 7800
 8350 PRINT "   YOU CAN ALSO CREATE AND MAKE CHANGES IN A DISK FILE OF INSULATIN
      G SLEEVES    WHICH ARE NORMALLY KEPT IN STOCK IN     YOUR FOUNDRY.  THE SI
      ZE OF EACH SLEEVE  MAY BE SPECIFIED USING EITHER IMPERIAL"
 8400 PRINT "OR METRIC UNITS.  SLEEVES OF THE SAME   DIAMETER BUT DIFFERENT LENG
      TH SHOULD BE ASSIGNED NOMINAL DIAMETERS WHICH DIFFER BY AT LEAST 0.01 INCH
      ES.":
      PRINT :
      GOSUB 600:
      IF R$ = "B" GOTO 7800
                              +--------------------------+
 8750                         !  RECOMMENDED PROCEDURE   !
                              +--------------------------+
 8800 HOME :
      PRINT :
      PRINT "RECOMMENDED PROCEDURE:":
      PRINT :
      PRINT "   AFTER ENTERING THE DATA REQUIRED IN ":
      INVERSE :
      PRINT "CUSTOMER/CASTING INFO";:
      NORMAL :
      PRINT ". YOU WILL NORMALLYREDUCE THE CASTING TO A COMPOSITE OF"
```

```
 8900 PRINT "ELEMENTARY SHAPES  (BARS,  PLATES,      CYLINDERS, ETC.).":
      PRINT :
      PRINT "   THEN YOU WILL PRINT OUT A TABLE OF   POSSIBLE FEEDING LENGTHS WI
      THIN EACH    SECTION, USING THE ";:
      INVERSE :
      PRINT "FEEDING DISTANCE":
      NORMAL
 9000 PRINT "OPTION.":
      PRINT :
      GOSUB 600:
      ON R$ = "F" GOTO 9300:
      IF R$ = "B" GOTO 8300
 9200 PRINT "   FOR PARASITIC SECTIONS, UNLESS MORE  ACCURATE DATA IS AVAILABLE.
       YOU SHOULD  ASSUME THE FEEDING DISTANCE WILL BE THATOF A SECTION FED DIRE
      CTLY BY A RISER.":
      GOSUB 600:
      IF R$ = "B" GOTO 8300
 9300 HOME :
      PRINT :
      PRINT "RECOMMENDED PROCEDURE (PART 2):":
      PRINT :
      PRINT :
      PRINT "   NEXT YOU WILL CHECK THE CASTING      FOR HOT SPOTS, AND PLAN TO
      PLACE A      CHILL OR A RISER AT EACH OF THEM,"
 9400 PRINT "NOTING THAT PLACEMENT OF A CHILL WILL   MARK A DIVISION BETWEEN SEP
      ARATELY      RISERED SECTIONS.":
      PRINT :
      GOSUB 600:
      ON R$ = "F" GOTO 9700:
      IF R$ = "B" GOTO 8800
 9600 PRINT :
      PRINT "   YOU WILL THEN PLACE SUPPLEMENTARY    RISERS BY MAKING USE OF THE
       FEEDING     DISTANCE TABLE ALREADY IN HAND AND      USING BLOCK CHILLS, T
      APER CHILLS, OR    PADDING AS REQUIRED.":
      GOSUB 600:
      IF R$ = "B" GOTO 8800
 9700 HOME :
      PRINT :
      PRINT "RECOMMENDED PROCEDURE (PART 3):":
      PRINT :
      PRINT :
      PRINT "   ONCE YOU HAVE DECIDED ON THE LOCATIONOF EACH RISER, YOU SHOULD U
      SE THE "
 9800 INVERSE :
      PRINT "CASTING SHAPE/SIZE":
      NORMAL :
      PRINT " OPTION TO ENTER THE  VOLUME,  SURFACE AREA, JUNCTION AREAS,  AND C
      HILL AREA FOR THE (SUB-) SECTIONS  TO BE FED BY A GIVEN RISER."
 9900 GOSUB 600:
      ON R$ = "F" GOTO 10100:
      IF R$ = "B" GOTO 9300
10000 PRINT :
```

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      PRINT :
      PRINT "   THEN THE ":;
      INVERSE :
      PRINT "RISER SIZE/NECK";:
      NORMAL :
      PRINT " OPTION      WILL CALCULATE THE BEST PARAMETERS      FOR THE RISER
      CONFIGURATION OF YOUR     CHOICE.":
      GOSUB 600:
      IF R$ = "B" GOTO 9300
10100 HOME :
      PRINT :
      PRINT "RECOMMENDED PROCEDURE (PART 4):":
      PRINT :
      PRINT "   IN ORDER TO FIND THE LOWEST COST     RISER/NECK CONFIGURATION, Y
      OU WILL ENTERTHE ";
10200 INVERSE :
      PRINT "COST ANALYSIS";:
      NORMAL :
      PRINT " CALCULATION FOR EACH  RISER TYPE YOU ARE CONSIDERING.":
      GOSUB 600:
      ON R$ = "F" GOTO 10800:
      IF R$ = "B" GOTO 9700
10300 PRINT :
      PRINT "   WHEN YOU ARE SATISFIED WITH THE RISERDESIGN, YOU SHOULD SAVE THE
       SECTION/    RISER DATA TO DISK FOR LATER REFERENCE, USING ";:
      INVERSE :
      PRINT "QUIT/SAVE FILES TO DISK";:
      NORMAL :
      PRINT ".  THEN ";
10400 PRINT "YOUCAN CARRY ON TO DESIGN THE NEXT RISER   REQUIRED BY THE CASTING.
      ":
      GOSUB 600:
      ON R$ = "F" GOTO 10800:
      ON R$ = "B" GOTO 9700:
      PRINT :
      PRINT "   YOU CAN RELOAD THE SECTION/RISER     DATA FROM DISK FOR RE-ANALY
      SIS, VIA THE"
10600 INVERSE :
      PRINT "CUSTOMER/CASTING INFORMATION";:
      NORMAL :
      PRINT " OPTION.":
      GOSUB 600:
      PRINT :
      IF R$ = "B" GOTO 9700
10800 HOME :
      PRINT :
      PRINT "RECOMMENDED PROCEDURE (PART 5):":
      PRINT :
      PRINT :
      PRINT "   IN ORDER TO OBTAIN A COST ANALYSIS   FOR THE ENTIRE CASTING, YOU
       MUST ENTER  THE ";
10850 INVERSE :
```

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      PRINT "GATING SYSTEM";:
      NORMAL :
      PRINT " OPTION TO SUM THE     RISERED SECTIONS AS STORED ON DISK, AND DEFI
      NE THE PARAMETERS OF THE GATING     SYSTEM FOR THE CASTING."
10900 GOSUB 600:
      ON R$ = "F" GOTO 17300:
      ON R$ = "B" GOTO 10100:
      PRINT :
      PRINT
11100 PRINT "   IF YOU WANT TO SAVE YOUR GATING      SYSTEM PARAMETERS, YOU MUST
       SAVE THE    CUSTOMER/CASTING INFORMATION FILE "
11200 INVERSE :
      PRINT "AFTER";:
      NORMAL :
      PRINT " LEAVING THE GATING SYSTEM OPTION.":
      GOSUB 600:
      IF R$ = "B" GOTO 10100
17300 PRINT :
      HOME :
      VTAB 10:
      HTAB 10:
      PRINT "END OF INSTRUCTIONS.":
      PRINT
17400 GOSUB 600:
      ON R$ = "B" GOTO 10800:
      CALL 778:
      GOTO 17400

                          +----------------------------+
63998                     !                            !
63998                     ! 28 MARCH 1984              !
63998                     !                            !
64000                     ! M.R. VINER/R.W. SMITH      !
64000                     ! METALLURGICAL ENGINEERING  !
64000                     ! QUEEN'S UNIVERSITY         !
64000                     ! KINGSTON, ONTARIO  K7L 3N6 !
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VARIABLE CROSS REFERENCE:

R$	100	600	650	700	800	900	1000	1200	1700	1800	2000	2150
	2300	2500	2800	3000	3200	3400	3600	3800	4100	4200	4300	4315
	4330	4340	4500	4700	5000	5100	5410	5450	5600	5750	5800	6000
	6300	6500	6800	7000	7200	7500	7700	7900	8100	8310	8400	9000
	9200	9400	9600	9900	10000	10200	10400	10600	10900	11200	17400	

NOTES:

* INDICATES SYMBOL REFERENCED AT ONE LINE NUMBER ONLY.
** INDICATES SYMBOL EQUIVALENT TO PREVIOUSLY DEFINED SYMBOL.
-> INDICATES UNDEFINED SYMBOL.

LINE NUMBER 99999 ==> TOO MANY REFERENCES TO THE VARIABLE:
LATER REFERENCES ARE NOT LISTED.

CANMET RISERING PROGRAMME

MAGNETIC DISK